Industrial Development Subsidiary Agreement

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Ministry of Industry and Small Business Development

Government of Canada
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Regional Economic Expansion
Expansion Économique Régionale

THE DEMAND FOR INDUSTRIAL LAND IN THE VANCOUVER LOWER MAINLAND

VOLUME I - MAIN REPORT

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THE B.C. MINISTRY OF INDUSTRY & SMALL BUSINESS DEVELOPMENT
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The responsibility for the content of this report is the consultant's alone, and the conclusions reached herein do not necessarily reflect the opinions of those who assisted during the course of this investigation or the Federal and Provincial governments which funded the study.

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INDUSTRIAL LAND DEMAND IN THE LOWER MAINLAND

I. INTRODUCTION & OBJECTIVES

A. INTRODUCTION

There are a number of industrial land issues confronting the four Regional Districts in the Lower Mainland. In a broader context, the B.C. Ministry of Industry & Small Business Development and the Federal Department of Regional Economic Expansion are interested in also understanding the long range implications of Lower Mainland development patterns on the rest of the province. Consequently, the three levels of government agreed to collaborate on a comprehensive study of industrial land in the Lower Mainland.

This document presents the results of a comprehensive study which analyzed the determinants of industrial land demand and forecast industrial land demand in the Lower Mainland by region through 2001. The study was undertaken on behalf of the Ministry of Industry & Small Business Development by Currie, Coopers & Lybrand. The results of the study are presented in three parts:

The results of the demand study are presented in three parts:

The Executive Summary presents a capsule report of the major findings of the study. An overview of the study methodology is presented, followed by a discussion of key determinants of demand for industrial land. Finally, the summary reports on the forecast for industrial land demand in each of the regions in the Lower Mainland.

The Main Report provides a detailed discussion of the study process and results. The Report introduces previous works in the area of forecasting industial land demand, and discusses how this study has attempted to overcome some of the shortcomings of these studies. Building on that discussion, the Report provides a summary of the methodology used to: collect historical land data; determine the key factors which impact businessmen's industrial land decisions; and develop a forecasting model. The main body of the Report presents a detailed discussion of the findings with regard to land and the geographical location requirements issue. The forecast results are presented in detail, outlining the basic economic assumptions used to drive the forecast, the implications of the forecast in a province-wide context, and the resulting land demand in each region. Finally, the report summarizes the key findings of the study, highlighting those points which merit further investigation.

The Technical Report documents the methodology used for data gathering and modelling in more detail. The industry interview program is discussed in detail, as is the forecasting model which was constructed. The Technical Report also discusses ways in which the forecasting model can be manipulated to develop alternative forecasts and to conduct policy analysis. Finally, a number of appendices containing backup documentation and data are included.

B. OBJECTIVES

In designing a study methodology, and throughout the execution of the assignment, Currie, Coopers & Lybrand's study team continually referred back to a set of objectives agreed upon with the client at the outset of the study. Specifically, it was agreed that the following requirements deserved emphasis:

- The study must address the underlying factors which drive industrial land demand.

- Changes in the province's economic activity must be anticipated and allowed for in the future utilization of the study. Specifically, changes must be allowed for: in the size and composition of the province's industrial base; in factors affecting demand for land between various regions within the province; and in the unit land requirements of each industry operating within the province.

- The study must develop an acceptable level of detail in key areas. Specifically, data must be gathered and analyzed on historical industrial land use, and the corporate decision-making structure broken out by industry sectors.

- The study must incorporate and facilitate discussions of important policy issues. Therefore, the resultant forecasting model must allow policy makers the ability to ask "what if" questions regarding the major factors which fall within their domain.

- The study should discuss the impacts of industrial development forecasts for the Lower Mainland on the rest of the province.

In response to these study objectives, study efforts have been directed at producing a number of tangible benefits to the study sponsors. These include the following:

- Historical data on industrial land consumption has been gathered from each of the lower mainland regions, and documented in one place.

- As a result of a broad interview program with senior industry executives, the key factors determining unit land demand for a given level of production have been identified and quantified.

- The key factors affecting regional location of productive capacity within the province have been identified and quantified by virtue of the same interview program.

- A detailed computer model has been developed to produce forecasts of regional output and of unit land requirements by region and industry sector, and subsequently, total industrial land demand.

- A detailed set of forecasts have been prepared which examine emerging trends in changes in the industrial mix within each region, unit land requirements, and the resulting demand for industrial land in each of the lower mainland regions.

- By providing each study sponsor with a computer readable copy of the model, each user group has the ability to quickly examine the potential impacts of any policy changes under their domain.

This report provides the reader with an overview of the study methodology, a detailed statement of the findings with regard to the determinants for industial land demand, and the forecasts by region through the year 2001.

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II. REVIEW OF PRIOR ANALYSES AND FORECASTS

This section reviews the methodology and conclusions of other studies that have been undertaken to forecast industrial land demand in the Lower Mainland. The review was useful in order to identify some of the shortcomings of those studies, in order to better equip the study team to design a methodology which might overcome them.

Several studies have been undertaken which anticipate industrial land demand in the Lower Mainland for the period under study. These include:

- GVRD Planning Department, "Industry and the Official Regional Plan", (unpublished paper).
- David Baxter, "Industrial Land in the GVRD: An Analysis of Recent Data", December, 1981, (unpublished paper).
- Phil Paulson, GVRD, "Industrial Development: Views and Issues of the Industrial Community", May 1976.
- GVRD, "Regional Prospects: A consolidation of Key Information on Trends and Forecasts for Greater Vancouver", September 1981.

Other more general studies also discuss the demand for industrial land. However, the above noted efforts are more directly relevant and are discussed below.

A. METHODOLOGY

The above studies encompass a range as well as a combination of methods which can be identified separately as follows:

- Interview Approach during which the authors consult with members of the planning and business communities in order to ascertain the expectations of those in the field.

- Analysis and Extrapolation of Historical Data, often modified in keeping with expectations as to how the region will change.

- Employment-Based Forecasts Based on Density Ratios. This method is the most popular among planners, and enjoys the broadest appeal as the method of forecasting industrial land demand both in and outside the Lower Mainland region. It entails a forecast of population which is then translated into industrial labour force using historical patterns or assumptions. This is then translated into industrial land demand using "density ratios" which express the number of acres per industrial worker, again generally based on historical patterns or assumptions.

B. FORECASTS

Forecasts noted above pertain mostly to the Greater Vancouver Regional District. Forecasts are not generally available for the other three Lower Mainland regions, except in the aggregate in the study by David Baxter.

Analysis by the GVRD Planning Department, in "Industry and the Official Regional Plan" used an industrial employment based approach on reaching the conclusion that from 1980 - 2001, 450 gross acres per year will be necessary to maintain the place of industry within the GVRD. In this case, gross referred to the useable land plus allowance for roads, commercial and other non-industrial uses that are ancillary to industrial development.

Another GVRD study - "Industrial Development: Views and Issues of the Industrial Community" used largely an interview-based approach wherein the author, Phil Paulson spoke with GVRD municipal officials, planners of crown corporations and some developers. His 1976 study concluded that, according to the sources he consulted, 350 - 400 acres of land each year will be demanded in the GVRD over the following decade.

In "Regional Prospects" which is also a GVRD publication summarizing past trends, no forecasts are made but it is indicated that in the years from 1975-79, an annual average of 420 acres per year were absorbed, primarily in the outer ring municipalities of the GVRD.

In "Industrial Land in the GVRD", David Baxter analysed the historical absorption rate of land in the GVRD, and industrial employment. He took what he anticipated the industrial component of the work force as projected by the GVRD would be, and applied to that a range of density ratios. To this projection, Baxter added a gross-up factor of 27% to 30% for roads and alleys. He also used an additional factor for translating the total net requirements into a gross total to account for the fact that industrial acreage will be lost due to changed use of some industrial sites. Therefore, in order to achieve the expected industrial activity, and in keeping with the history from 1976-81 as to the amount of land being "lost" from industrial use, a factor of 1.5 gross acres for every net acre required, was used. The range of forecasts offered in the study is broad, depending largely on different scenarios for industrial employment growth.

C. STUDY DRAWBACKS

Those studies undertaken in the Lower Mainland in the past all have one or more drawback:

- First, they are all based on assumptions and observations that are specific to the study authors. While this is true of any study, the problem is that those using the studies cannot readily employ that same logic, coupled with different or updated assumptions, and derive updated sets of forecasts.

- Second, the studies do not provide forecasts for each of the regional districts outside the GVRD.

- Third, all the studies are based on extremely limited data regarding land takeup and use.

- Fourth, since the studies use highly aggregated data, they do not adequately account for the changes in the industrial mix in the province as a whole or in each of the regions.

- Last, in the case of employment-linked forecasts, the relationships which drive the land forecasts are rather indirect. Land is not purchased to provide employment, nor are people employed for the purpose of populating industrial land: land and labour are both purchased as inputs to industrial activity. In the same way as it would seem inappropriate to forecast employment growth based on land demand, it seems equally inappropriate to forecast land demand based on employment growth.

As will be discussed in the following section on study methodology, an approach was developed and used to try and overcome some of these shortcomings, thereby adding to the accuracy of industrial land demand forecasts in the Lower Mainland.

III. OVERVIEW OF STUDY METHODOLOGY

Given the work which has been done to date on forecasting industrial land demand, and some of the shortcomings which have been noted in the previous section, a major motivating force in developing the methodology for this study was to take a fresh approach to the task. This study was conducted so as to provide answers to the following five questions:

- What is the linkage between industrial activity and industrial land requirements?

- What factors are important in determining in which region a company will locate a facility? To what extent do these factors vary in importance for different industry sectors? (For example, proximity to deep-sea ports may be critical for one industry sector, while proximity to in-province consumers may be more important to another.)

- What factors are important in governing the amount of land needed for any given level of output? (Hereafter referred to as "land density".) To what extent have factors such as increasing land costs and technological advances affected land density in different industry sectors?

- What patterns and trends have been evident in the recent consumption of industrial land in the Lower Mainland?

- How will these historical trends change in the future? How important are each of the three forces driving demand for industrial land (economic output, location issues, and land density) in determining total future industrial land in each of the four regions of the Lower Mainland?

In order to address these questions, the study was conducted in four phases:

1. Data Gathering

   - gathering of historical land use dat and output data by region by industry
   - collection of data, through an interview program, on the nature of the corporate decision-making process

2. Data Analysis

   - determination of key factors affecting demand for land by region and by industry
   - determination of key factors affecting location by industry

3. Construction of a Computerized Forecasting Model

   - design of model structure
   - coefficient estimation
   - model testing and validation

4. Forecasting Land Demand

   - development of the necessary forecast inputs to drive the model
   - development of a forecast for land demand through 2001
   - development of alternative demand scenarios, highlighting the key sensitivities surrounding the base case forecast

An important benefit derived from this study approach is that it lends itself well to future updates. As economic conditions change, model users can input new sets of assumptions and quickly and efficiently update the forecasts for land demand. Also as more and better data become available, the system can be easily disaggregated to a greater level of detail to gain added forecast accuracy.

The remainder of this section of the report provides a brief overview of the data collection phase, and an overview of the structure of the

computerized model. The subsequent two sections of the report present the study findings on the determinants of demand for industrial land, and the demand forecast through 2001 respectively.

A. DATA COLLECTION - HISTORICAL LAND USE & INDUSTRIAL OUTPUT

This part of the report briefly describes the land use data and industrial output data which have been used as the basis for analysis in this study.

1. Land Use Data

Land data for the 23 sectors which comprised the Project One inventory conducted by the four Lower Mainland regional districts form the basis for the land use data in this study. These data have resulted from field surveys by all four districts in keeping with the Standard Industrial Classification (SIC) categories at the two-digit level. Finer breakdowns (three-digit level), as well as site specific information for each land parcel (eg. site coverage), comprise the backup information used in the Project One exercise. As reported by each regional district which supplied the data, the data have the following characteristics:

- They are on an "as used" basis, rather than zoned or planned.
- They are on a legal parcel basis. Namely, the presence of a given industry on any portion of a legal parcel is sufficient to enable the entire parcel to be categorized according to that use.

In the case of the GVRD, the land data have been supplied under the Land Use Information System (LUIS). The categories according to that system should be congruent with the Project One output in terms of the higher level of aggregation used in this study.

Table 1

INDUSTRY SECTOR DESCRIPTIONS

10 SECTORS	GENERAL DESCRIPTION	PROJECT ONE SECTORS INCLUDED
Food	Food and beverage processing	Food
Wood	Pulp and paper mills, sawmills, veneer and plywood, wooden box and papers	Wood & Paper
Metal	Iron and steel mills, smelters and refineries, metal fabrication	Primary Fab. Metal
Chemical & Petroleum Products	Refineries, fertilizer manufacturers, pharmaceutical manufacturers, plastics, soap, rubber products	Chemical & Petroleum
Non-Metallic Minerals	Stone, glass, clay, cement products	Non-Metallic Minerals
Other Manufacturers	Electrical products, machinery, transportation equipment, printing and publishing, textiles	Textile & Clothing Printing & Publishing Machinery & Electrical Transportation Equip. Other Manufacturing Unknown Manufacturing
Wholesale Trade and Storage	Warehouse and wholesalers of various products	Wholesaling & Warehousing
Major Transportation	Airport, railway, railway right of way, pier	Airport Railway Right of Way Railway Pier
Other Transportation and Storage	Trucking and moving companies, bus depots, construction equipment and materials storage, car storage lots, sites where aggregates and raw materials are stored but not extracted or processed	Other Transportation Trucking Uses Storage Construction Equipment & Materials Storage
Utilities	Electric generating stations, gas distributing stations, powerlines and stations, sewrage treatment plants, microwave and TV/radio towers, B.C. Tel structures	Utilities Communication

The table on the facing page lists the 10 sectors used in this study, describing the major contents of each, and the Project One sectors which have been included in each.

The choice as to which Project One sectors should be aggregated together was made based on industry interview findings. By and large, the 10 sectors provide homogeneous groupings of industries from a land use planning perspective. It is expected that planning decisions would not be approached differently for any of the various industries within each category. The extent to which this is not true did not warrant the "stretching" of existing data given two major problems concerning availability of data.

The first problem concerns the availability of historical data on industrial land use. The only comprehensive source of historical data prior to 1981 was available under the GVRD LUIS system. These historical data were needed to analyse trends in changing land use patterns, and therefore a modified version of the LUIS categories was used, subject to the constraint of maintaining compatibility with the Project One data. The second constraint is related to historical data on industrial output in the province.

2. Historical Industrial Output Data

As will be discussed more fully in Section III, a key driving factor in analysing industrial land use demand is the level of industrial output in the province. The level of industrial disaggregation used in this study must therefore be constrained by the availability of disaggregated industrial output data.

Two primary sources exist for historical output data within the province: Statistics Canada; and the Central Statistics Bureau

(CSB) of the Ministry of Industry and Small Business Development.

Data from both of these sources has been used, and a more detailed description is provided in the Technical Report, Section II. In the case of both sources, the level of detail broken out by industrial sectors is limited even at the province-wide basis. Once the added requirement of regional disaggregation of output is imposed on the data, the amount of information available is even more limited.

In terms of producing long term land forecasts, this study relied on a long term provincial output forecast selected by the study team from a number of forecast scenarios provided by the CSB. A more complete discussion of that forecast is provided in Section V. For the reasons previously noted, this forecast does not have extensive industry detail, and this argued strongly for a more highly aggregated classification of industry sectors than is contained in the Project One data.

A more complete description of the historical data is contained in the Technical Report, Section II. Also, a set of appendices to the Technical Report contain tables of the actual data. Sections IV and V of this report contain the appropriate amount of detailed land and output data with which to analyse study results and forecasts, but these are at the more aggregated level noted previously in this section.

B. DATA COLLECTION - CORPORATE DECISION STRUCTURE

The series of interviews conducted with corporate decision makers served two purposes. First, the interviews identified the key factors which impact business decisions on the amount of industrial land to be consumed, and where to locate specific facilities. Second, once the appropriate factors were identified, the interviews provided the data needed to quantify these relationships.

Table 2

INTERVIEWS CONDUCTED

	Forest Products	Metal Fab, Primary Metal	Chemicals & Petroleum Products	Non-Metallic Mineral Products	Food & Beverage	Other Manu-facturing	Wholesale Trade Storage	Other Non Manu-facturing	Total
Total B.C.	10	9	2	5	5	8	4	7	50
Out-of-Prov.	1	1	2					2	6
Total	11	10	4	5	5	8	4	9	56

In total, 56 company interviews were conducted. Companies were chosen to provide a broad cross-sampling of industry sectors by company size and regional representation. Although the study focused on the intra-regional location decisions for companies inside B.C., a number of interviews were conducted outside of the province to test whether the issues identified as being important within the province also had validity in a broader geographical context. Based on a limited set of out-of-province interviews, this assumption was borne out. Table 2 provides a breakdown by industry sector of the 56 interviews conducted. Confidentiality of the interviews was assured by Currie, Coopers & Lybrand. Consequently, given the small number of firms operating in some industry sectors, particularly in the outlying regional districts, it is not possible to provide a breakdown of industry interviews by region.

A more detailed discussion of the interview process, and a copy of the interview questionnaire are contained in the Technical Report.

C. FORECASTING MODEL

Based on the information gathered during both phases of data collection, a computerized forecasting model was developed. The model forecasts total industrial land required, broken down by ten industry sectors in four regions of British Columbia. The study focussed on the Lower Mainland, and therefore the four regions modelled are:

- Greater Vancouver Regional District (GVRD)
- Central Fraser Valley
- Dewdney Alouette
- Fraser Cheam

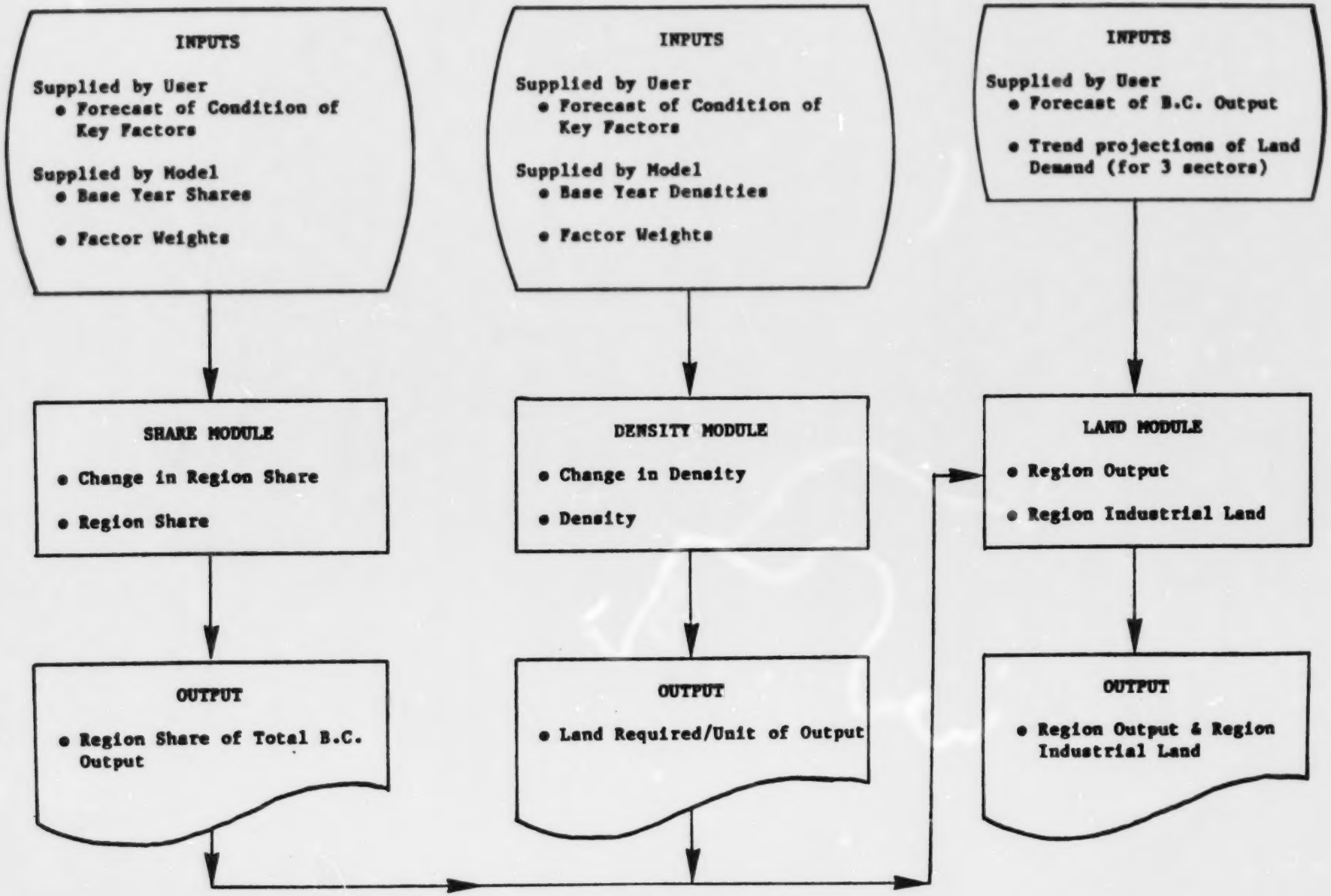
The 10 industry sectors which were broken out for each of the regions are:

- Forest Products
- Metal Fabrication, Primary Metal
- Chemicals, Petroleum Products
- Food and Beverage
- Non-Metallic Mineral Products
- Other Manufacturing
- Wholesale Trade & Storage
- Major Transportation Services
- Other Transportation & Storage
- Utilities

The analysis of industrial land needs, and the resulting forecasting model which was built, use regional output share by industry and land density (the amount of output per unit of land) by industry, as the cornerstones for producing forecasts for industrial land demand. This analytical framework was used for the six manufacturing industries and Wholesale Trade and Storage. In the case of the other three industries (Major Transportation Services, Other Transportation and Storage, and Utilities), this approach could not be used for two reasons. First, no output data are available for these sectors on a regional basis, or in some cases even on a provincial basis. Second, and perhaps more important, these sectors are essentially mixed use sectors, and not specifically industrial. Demand for land for airports, bus depots, used car lots, telephone switching stations, and ports to name a few, are driven by factors that are neither strictly industrial, nor restricted to growth of the Lower Mainland economy. Therefore, they are treated separately, allowing for user input directly on rates of growth in land demand. An analysis of the forecasts for these sectors is included in the forecast discussion in Section V.

Chart 1

SCHEMATIC OF THE FORECASTING MODEL



While the model focusses on land demand in the Lower Mainland, for completeness it was highly desirable to also model the "Rest of B.C." as a region competing for share of industrial output. Consequently, the model produces forecasts of output share and total output for the Rest of B.C. as well as for the four Lower Mainland regions. However, since no data on total industrial land in the rest of B.C. were available, land demand for this fifth region was not modelled.

Determination of demand for industrial land was modelled as a three-stage process. A schematic of the model structure is contained in Chart 1. The three modules are:

- a Share Module, which determines shares of total output by industry in each region as a function of region attractiveness,

- a Density Module, which determines the amount of land needed for a given sized facility or expansion (density) by industry as a function of the key determinants of density, and

- a Land Module, which determines the amount of land needed in each region and industry as a function of density, total provincial economic activity, and region share of output.

The reasons for breaking the model down into three modules are twofold. First, a three-stage model provides explicit information to the user regarding the ways in which overall economic activity, relative region attractiveness, and intensity of land use, each affect industrial land demand. Second, the segmented model gives the user greater ease in developing forecasts and analyzing "what ifs" and specific policy questions. While it is understood that each of the three decision stages are highly interdependent, the interview process confirmed that this modelling framework does not significantly distort reality.

Section IV of this report, (immediately following) presents the major study findings regarding recent trends in industrial land demand in British Columbia which form the conceptual basis for the model. Section II of the Technical Report provides a detailed description of the model structure and equations.

IV. DETERMINANTS OF DEMAND FOR INDUSTRIAL LAND

As noted in the previous section on study methodology, the analysis of regional industrial land requirements was broken down into two parts: analysis of the amount of land required; and analysis of the location decisions by region.

The study produced a great deal of information which was used to build the forecasting model. Also, a significant amount of information was developed which was not explicitly built into the model. This section of the report outlines both types of information.

The analysis of amount of land required by industry first focussed on establishing a major indicator relating industrial activity to land requirements. Once this relationship was established, the analysis focussed on determining those factors which have affected the magnitude of that relationship over time. The detailed discussion of study findings touches on the following issues:

- Industrial land is a derived demand.
- The level of output is the key factor in determining land requirements.
- The amount of land held in inventory is extremely large.
- Different industries require different amounts of land for a given level of output.
- Land density also varies across regions. (Density is defined in terms of the amount of output per acre of land.)
- Densities have been changing over time at different rates in different industry sectors.
- Aside from output levels, three basic categories of factors have influenced density change: costs, technology, and gross-ups.

- The relative importance of the factors affecting density varies across industry sectors.

A principle finding of this analysis shows that overall, industry is making more efficient use of industrial land, and therefore the demand for land has not increased at the same rate as provincial output. This has been measured in terms of a density ratio: the amount of output (measured in inflation adjusted 1981 dollars) divided by the amount of industrial land used. The second key finding is that the rate of change in this density ratio has been dramatically different across the various industry sectors, ranging from a high of 126% in the chemical industry over the last five years, to an actual decline of 18% in density in "other manufacturing" over the same five year period. The third major finding is that the increase in the density ratio has been primarily brought about by increases in land costs (both purchase price and holding costs) motivating manufacturers to make more efficient use of land. Technology has also played a role in increasing the efficiency of land, whereas more stringent regulations imposed by government have tended to work towards reducing the efficiency of land.

Turning to the question of regional location of industrial sites within the province, the discussion has been broken down into five points:

- Given total provincial output, industrial land requirements in a region are a function of output share for the region.

- Nine basic factors were identified which influenced decision-makers on where to locate. These are: relative land costs, distance from markets served, transportation infrastructure, land availability, local labour supply, proximity to raw materials, operating costs, government grants, and lifestyle.

- The importance of each of the factors varies across industry sectors as a function of industry structure.

- Each of the B.C. regions scores differently on each factor, and given relative importance weightings of factors by industries, the relative attractiveness of regions fluctuates.

- Region shares of output have been changing over time in response to regions' relative attractiveness.

Overall, the Lower Mainland has been capturing an increasing share of total provincial output over the past five years. In fact, its share of output has increased from 45% in 1976 to 53% in 1981. In absolute terms, the majority of that increase has gone to the GVRD, but in terms of rates of growth, the outlying districts have performed significantly better.

Overall, the GVRD has been rated as the most attractive region in which to locate, but this relative attractiveness has been declining over time. This has come about primarily as a function of tremendous increases in land costs, while the outlying regions have been improving in terms of other important factors such as transportation infrastructure and proximity to major markets (owing to population shifts). Consequently, while the GVRD still accounts for the majority of output (and therefore industrial land consumption) the other Lower Mainland regions are attracting an increasing share of production, both as compared to total province output and total Lower Mainland output. In the case of total Lower Mainland output, GVRD share has dropped from 90% in 1976 to 88% in 1981.

By combining the two pieces of analysis on density and location, it is possible to identify the key trends in industrial land requirements by region. In the GVRD, a significant increase in output density has worked to largely offset increases in output, therefore lowering the rate of increase in industrial land demand. In the case of the other three regions, while density is expected to continue to increase, the overall rate of growth in output is likely to be more dramatic by comparison, suggesting greater rates of growth in demand for industrial land in those regions. The detailed analysis of these trends broken out by industry sector further highlights the interrelationships between density, region attractiveness, and the overall industrial mix within regions.

AMOUNT OF LAND

1. Industrial Land is a Derived Demand.
2. The Level of Output is the Key Factor in Determining Land Requirements.
3. The Amount of Land Held in Inventory is Extremely Large.
4. Different Industries Require Different Amounts of Land for a Given Level of Output.
5. Land Density Also Varies Across Regions.
6. Densities Have Been Changing Over Time at Different Rates in Different Industry Sectors.
7. Aside From Output Levels, Three Basic Categories of Factors Have Influenced Density Change: Costs, Technology, & Gross-ups.
8. The Relative Importance of the Factors Affecting Density Varies Across Industry Sectors.

A. AMOUNT OF LAND

This part of the report identifies the key factors determining the amount of land required by industry. The major headings for this part have been produced on the facing page for quick reference.

1. Industrial Land is a Derived Demand

The interview process produced virtual unanimity on this point. Industrial land is viewed as a required input to the production process, and the amount of land purchased is therefore determined as a function of the level of activity anticipated by the company.

While interviewees responded in different levels of detail, they all described the same basic process for determining land requirements. Essentially, a "bottom-up" engineering approach is used:

- A desired capacity level is chosen and a subsequent plant layout is determined. This serves as the core land requirement (ie. an amount of land equal to the surface area of the plant).

- Land requirements for inventory and shipping are determined based on expected output levels.

- Ancillary requirements for "people space" such as administrative offices, employee lunchrooms, parking, etc. are arrived at, and added in to the land requirements.

- Required setbacks, landscaping, road access, etc. are calculated and added in.

- Finally, depending on the company's projected future growth and attitude towards relocation, additional land for expansion might be added in.

Consequently, this study analysed land needs on a "gross" basis (ie. including setbacks, buffer, etc.)

2. The Level of Output is the Key Factor in Determining Land Requirements

Interview findings confirmed that each of the five steps noted in the preceeding segment are related to output levels. The first two steps for determining land requirements are linked to a forecast of peak output for the facility as it is currently being designed. In the case of requirements for people space, requirements are first tied to employment levels, which are directly tied to the expected level of output. The amount of land required for setbacks and buffer is tied to output through the preceeding three steps: once land requirements for the preceeding three purposes has been determined as a function of output, land required for this purpose can be "grossed up". Finally, while land for future expansion is not a function of current output levels, it is tied directly to expected output in the long term.

Given these findings, a decision was reached to use industry output as the major factor in analysing historical land requirements and projecting future land requirements. Consideration was given to using different industry activity measures to analyse each of the five steps (capacity additions, output levels, employment levels, zoning regulations, long term growth rates). However, this alternative was rejected since the

introduction of at least five factors into the analysis would perhaps further complicate the process of forecasting industrial land rather than simplifying it. Once a decision was reached to use only one factor, industrial output was chosen for two reasons:

- it serves as a good representation of each of the other measures, and

- other than employment, it is the only measure for which data are available in any reasonable level of industry detail and regional detail.

When analysing the relationship between output and land required, it is necessary to keep two related issues in mind. First, since land is purchased in discrete parcels, the relationship between output (which can change very quickly) and land used (which is fairly fixed over the short term) is an imperfect one. Second, since land is purchased for anticipated future growth, one would expect an automatic bias over time which favours increased output per given unit of land. This phenomenon has been observed and is discussed more fully in the segment immediately following.

3. <u>The Amount of Land Held in Inventory is Extremely Large</u>

Data do not exist which differentiate between industrial land in use from that which is currently being held in inventory on a given site. However, the interview process collected sample information in this regard.

Responses ranged from cases where as much as 75% of the purchased site was in excess of current needs, to cases where absolutely no excess land was purchased. The vast majority of responses indicated some amount of land purchased in excess of current

needs. The principal reason stated for purchase of additional land was to allow for future growth. Companies feel it is often less costly to allow for additional growth on the existing site rather than risk having to relocate when the current facility is outgrown.

Two other reasons were given for land banking. First, many people consider land to be a good investment, and businessmen are no exception. A number of interviewees responded that the parcel they purchased looked attractive from a price point of view, and although the amount of land was far in excess of what they needed, they suspected they could make money on the transaction. It was not necessarily clear to them whether they expected to become landlords at some later date, or subdivide the space and sell a piece off. In either case, they voluntarily purchased excess land in the hopes of making a profit on it. Not surprisingly, this behaviour was observed more in the smaller, privately held companies than the very large companies. The owner of the small company generally has more flexibility and is willing to pursue an opportunity to make money that is not directly related to his line of business. On the other hand, many of the executives of large corporations responded that "We are in the business to manufacture widgets, not speculate in land".

The second additional reason cited for land banking was involuntary. Once a decision was made to purchase land with certain physical requirements, an ideal parcel was identified that met all characteristics except that the parcel was far in excess of current needs. If it was not possible to negotiate a subdivision of the parcel in order to purchase the piece required, the company purchased the entire parcel rather than give up the ideal site. While this phenomenon is best viewed as involuntary inventory accumulation, in most cases the respondents who gave this reason indicated that they were not terribly upset

with the outcome given that land is generally a fairly safe investment.

It was possible to determine some variation in land banking practices across industry sectors. At one extreme, the chemical industry and forest products industry purchased large amounts of inventory land as a matter of policy. Both industries have very specific and strong regional preferences (to be discussed in Section B following) and are capital intensive. The combination of these two factors means that an unwanted relocation brought about by insufficient land on the current site is very costly. Two chemical companies interviewed in B.C. and one in Alberta stated that they would not even consider purchasing a site that did not have sufficient space to allow for future growth for at least another 20 years. It is not surprising, then, to note that over the past five years industrial land used by the chemical industry in GVRD has remained fairly constant around 1900 acres while output has jumped from $800 million (1981 dollars) in 1976 to $1800 million in 1981.

Industries which are less capital-intensive and have less demanding physical requirements for their industrial site tend to be more conservative in their land banking practices. Light manufacturing and wholesale trade interviews generally produced answers on the more conservative end of the land banking spectrum. In the wholesale trade industry, it was also noted that land (for warehousing and storage) represents a very large proportion of their capital costs and this industry sector therefore makes as efficient use of land as possible.

In this study, inventoried land was considered one of the most important issues to be dealt with. As noted previously, a major problem is that data do not exist which differentiate between industrial land currently in productive use and land held in inventory. Second, the current classification of land use by

industry sector is based on primary use. Consequently, in cases where a piece of an existing parcel has been subleased to a company in a different industry sector, this will not show up in the existing data.

Since the data are imperfect, the analysis does not explicitly identify changes in industrial land held in inventory. Rather, changes in the output to land density ratio over the forecast horizon implicitly capture adjustments in land inventory levels.

4. Different Industries Require Different Amounts of Land for a Given Level of Output

As with any other factor of production, the amount of land required per unit of output changes for different industry sectors. This is a function of:

- the production process,
- the amount of land needed to inventory raw materials, work in process and finished goods,
- shipping and transportation needs (rail spurs, loading docks, etc.),
- labour intensiveness as it impacts parking, lunchroom facilities, etc., and
- different needs for buffer zones (eg. lots of "safe" space around an explosives factory).

The differences in densities across manufacturing industries are quite dramatic. The food industry makes the most intensive use of land, with output in 1981 in GVRD at $2.62 million per acre. At the other end of the spectrum, the non-metallic minerals industry requires much more land per dollar unit of output, with

Table 3

1981 DENSITY RATIOS
(MILLIONS OF $81 PER ACRE OF LAND)

	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM
FOREST PROD.	0.68	0.29	0.70	0.60
METAL FABR.	0.90	0.95	1.00	1.00
CHEMICAL	0.95	1.00	1.00	0.03
NON MET MIN.	0.48	0.10	0.12	0.10
FOOD & BEV.	2.62	1.30	2.21	2.26
MISC MANUF.	1.64	0.81	1.36	1.19

the 1981 GVRD ratio of $.48 million output per acre. Table 3 on the facing page provides density information for each of the four lower mainland regions.

5. Land Density Also Varies Across Regions

As portrayed in the Table, the density ratios across regions vary quite dramatically. In the case of the food industry, output per acre in Central Fraser is approximately one half the levels achieved in the GVRD. In the case of non-metallic minerals, the regional difference between Central Fraser and GVRD is even more dramatic, with the GVRD achieving approximately five times the output per acre as that achieved in Central Fraser.

The higher densities in GVRD are not surprising. They are a function of the maturity of the region (hency greater take-up of inventoried land for expansion); limited availability of additional land; and higher land prices which push towards more intensive use of land. In other words, densities are a function of the regional conditions of the factors which affect density.

The regional differences are self-evident from the Table. However, one interesting observation is perhaps not immediately apparent. Although the density levels are different from region to region, the rank ordering of industry densities within each region is almost identical across the four regions. The food industry has the highest density in all four regions, and at the other end of the spectrum, wood products and non-metallic minerals hold positions five and six respectively in all regions. Metal fabrication, chemicals, and other manufacturing hold the middle positions.

One of the major purposes of this study was to identify the factors influencing changes in density across industries and regions, and study findings will be presented in the discussion

Table 4

CHANGES IN DENSITY IN THE GVRD

	1976	1981	% CHANGE
FOREST PROD.	0.64	0.68	6
METAL FABR.	0.62	0.90	45
CHEMICAL	0.42	0.95	126
NON MET MIN.	0.25	0.48	92
FOOD & BEV.	2.15	2.62	22
MISC MANUF.	1.98	1.64	-17

immediately following. As a cautionary note, when examining specific density data, it is important to keep in mind that the raw data are not as "clean" as would be desired. As discussed more fully in the Technical Report Section I, the industrial output data for regions other than the GVRD are incomplete. Also, there may be some problems with the uniformity of the land data across regions with regard to primary usage, site coverage, and completeness of the data. Consequently, while the study findings are certainly indicative of major trends and developments across regions and industries, specific density ratios are likely misleading if used strictly at face value.

6. Densities have been Changing Over Time at Different Rates in Different Industry Sectors

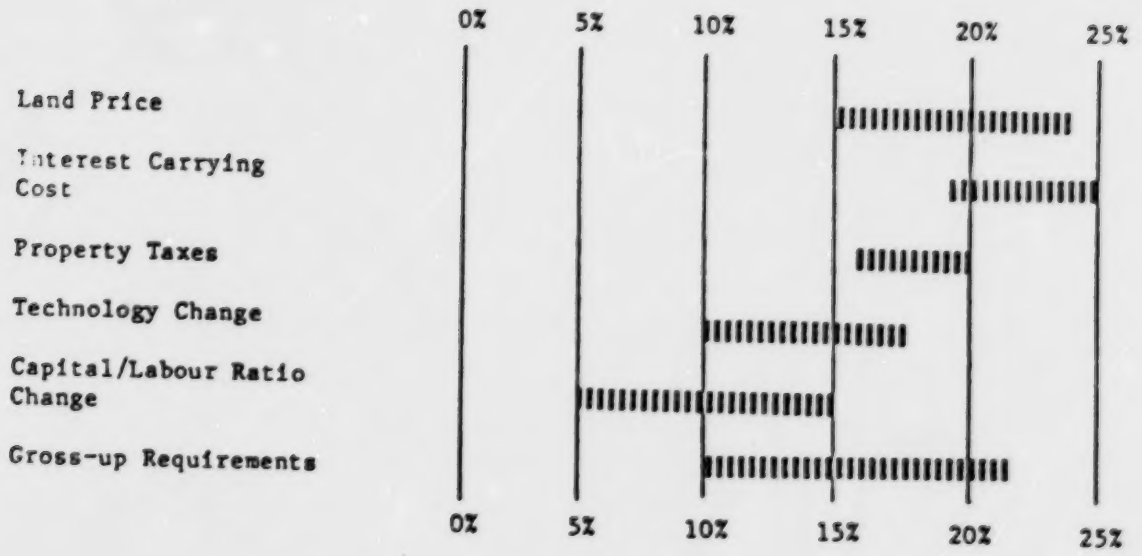
GVRD is the only region for which comprehensive industrial land data broken out by industry sector are available prior to 1981. Hence, a discussion of density changes will draw on impirical results from that region only.

With the exception of the other manufacturing sector, industry has been achieving greater output per acre over the last five years. Density data for 1976 and 1981 for the GVRD are shown in Table 4 on the opposite page. The most spectacular change in density has been achieved in the chemical industry. As noted previously in this report, this industry has agressively purchased inventory land for future expansion in order to virtually guarantee that companies will not have to relocate in the foreseeable future. Consequently, while land required has actually declined by 34 acres, real output has gone up in those five years at an average annual compound growth rate of 29%. Hence, output per acre has more than doubled from $0.42 million per acre in 1976 to $0.95 million per acre in 1981. The non-metallic mineral sector has achieved almost as dramatic an increase in density, jumping from $0.25 million dollars per acre

Chart 2

RELATIVE IMPORTANCE OF FACTORS IN EXPLAINING DENSITY CHANGE

(RANGE OF RESPONSES ACROSS INDUSTRY SECTORS)



in 1976 to just under $0.5 million dollars in 1981. The wood products industry has seen practically no increase in density over the last five years, and as noted previously, the other manufacturing sector has actually declined in density by approximately 18% over the five years.

This discussion focusses on changes in density across industry sectors. However, it does not address density changes across regions. Unfortunately, no historical data are available on industrial land by industry sector for any region other than the GVRD, so this issue cannot be effectively dealt with. Consequently, forecasted rates of change in densities for different industries has been held relatively constant across regions. Density levels are different across regions, but the impacts of conditions affecting density for a given industry are assumed to be equal across regions. That is to say, a given change in the relative price of land in any region will result in the same percentage change in the density in industry in that region as it would in another region.

The next segment outlines the study findings regarding the key common factors which affect density over time. The segment following then presents the specific findings regarding the ways in which these common factors exert different impacts in different industries.

7. Aside from Output Levels, Three Basic Categories of Factors have Influenced Density Change: Costs, Technology, and Gross-ups

A number of specific factors were identified by each of the companies interviewed as to the reasons why output per unit of land has changed over time. All of the responses can be placed into one of three categories: land costs; changes in production technology; and regulated and non-regulated gross-up requirements. Chart 2 on the facing page shows the range of

responses on the relative importance of the major factors affecting density change.

Land costs were generally considered to be the most important factor affecting changes in density. On average, respondents indicated that somewhere between 50% and 65% of the change in the output to land ratio over the past five years was due to changes in land costs. More specifically, land costs were broken down into two parts:

- land purchase price, which accounted for between 15% and 25% of observed change in density, and

- land carrying costs, which accounted for approximately 30% to 40% of observed density change. This latter factor was broken down into two parts during the interview: interest carrying costs, and property taxes.

Over the past five years, rapidly escalating land prices, coupled with high interest rates and increased property taxes have been a major force in motivating companies to economize on land. This has manifested itself through a number of specific actions:

- Companies are selling off unneeded land held in inventory.

- Companies are less willing to purchase a parcel of land bigger than that which is required.

- Rather than relocating or purchasing additional land, companies are attempting to make more efficient use of existing space.

- As well as making more efficient use of space through better application of existing technology, companies are introducing

new production technologies to increase land and labour productivity.

- Finally, many companies which had provided "luxurious" amounts of space for parking, office space, landscaping, etc., are now trying to get by with the absolute minimum in terms of the gross-up requirements which are partially discretionary.

The latter two points were broken out specifically during the interviews in order to capture the magnitude of their effects. In the case of changes to the productive process, two factors were identified:

- changes in technology which affect production per land unit, and

- substitutions between capital and labour in the production process, which in turn alter production per unit of land.

Virtually all respondents indicated that technology changes have tended to increase the productivity of land. This was primarily seen as a function of introduction of new machinery which could increase the rate of production without an equivalent increase in the size of the machine (hence amount of land required). This impact was by far the most significant, however some technology changes observed had the opposite effect. For example, the trend away from vertical production plant layouts to horizontal production plants increased land requirements. However, on net these negative factors were definitely outweighed by the improved technology. Technology was seen as significantly increasing the output to land ratio, accounting for roughly 10% to 15% of the effect of the total density change observed over the past five years, with two industry sector responses outside this range: one at 6% and one at 20%.

Table 5

RELATIVE IMPORTANCE (%)
OF FACTORS IN EXPLAINING
DENSITY CHANGE

	Forest Prod.	Metal Fabr.	Chem.	Non-Met Min.	Food & Bev.	Misc Manuf.	Wholsl Trade
Land Price	24	21	15	24	20	18	24
Interest Carrying Costs	22	22	17	25	19	20	25
Property Taxes	20	19	17	16	17	18	17
Technology Change	12	11	21	11	15	15	6
Capital/Labour Ratio Change	12	14	7	5	16	12	10
Gross-Up Requirements	10	13	22	29	14	17	18
	100	100	100	100	100	100	100

Changes in the capital/labour ratio also had a positive impact on the output to land ratio. While it was expected that changes to the capital labour ratio would only be introduced if they increased the total output to total cost ratio, it was unclear that the cost savings would necessarily come through more effective use of land. That is, changes in the capital/labour ratio could be used to reduce labour costs in times of rapidly increasing wage rates, but this could have come at the expense of some additional land being required on which to situate the new machinery. However, respondents indicated that whereas the effect of changes in the capital/labour ratio on density was somewhat less than other changes in technology, the effect was in fact to reduce the land required for a given level of output.

The final factor having a significant impact on density change is "gross-up" requirements such as buffer zones, public access, required setbacks, etc. As noted previously, the increasing costs of owning land tended to impact on the discretionary aspects of the gross-up requirements. However, respondents indicated overwhelmingly that the legislated requirements for gross-up factors have become significantly more onerous and have more than offset discretionary savings, resulting overall in a net decrease in the output to land ratio due to this factor: Since increasing amounts of land are required for "non-productive" use, but are still part of the total land parcel, output is "spread" over a bigger piece of land, thereby reducing density. On average, changing gross-up requirements were seen to account for approximately a 15% reduction in the density change which would have otherwise occurred.

8. The Relative Importance of These Factors Affecting Density Varies across Industry Sectors

As noted previously, density has been changing at different rates in different industries. This segment of the report marries together the information collected on the relative importance of the various factors in affecting density across industries with

observed changes in density in those industries in order to provide a solid basis for forecasting future density changes.

The most dramatic change in density was observed in the chemical industry. To the largest extent, this was a function of the industry's practice to bank enough land to allow for long term expansion on existing sites: as output went up and land was held constant, the ratio improved. Additionally, respondents in this industry indicated that there have been tremendous improvements in chemical processing technology, allowing for far greater throughput for a given sized plant. Whereas the average response on the impact of technology change was between 10% and 15% for other industries, the chemical industry response averaged 20%. Offsetting this, the chemical industry feels it has been particularly hard-hit by legislative gross-up requirements, specifically with regard to larger setbacks and the need for additional land to control pollution one way or another. As noted previously, land costs were seen as relatively unimportant in the chemical industry as compared to other industries. The costs of relocation are considered so significant that there is an overriding sentiment to be more than generous in banking land irrespective of price rather than risk incurring relocation costs.

The non-metallic minerals sector achieved the second most dramatic increase in density over the five-year period, jumping by 92%. The industry is particularly sensitive to interest carrying costs and other land costs, and has dramatically reduced land inventories. Some improvement in density was also observed as a result of improvements in technology and changes in the capital/labour mix. However, compared to other industries, the non-metallic minerals industry performed more modestly in this regard.

The metal fabrication industry achieved a 45% improvement in density over the past five years. The major impact has been through takeup of inventory land, and some selling off of unneeded parcels. Technology changes were viewed as having had

some positive impact on density, but relative to land costs, the impacts were considered to be fairly small. Furthermore, the rate of improvement and density due to technology change is seen to be slowing down in this industry.

The food industry achieved a 22% increase in density which was particularly impressive given the fact that the industry already produced more output per acre in 1976 than any other industry. By 1981, the industry was producing more than double the output per acre of the overall GVRD average. The industry performed slightly better than average in terms of the impact that technology had on density, and stood out significantly better in terms of changes to the capital/labour ratio. The industry has seen a fair amount of automation which has significantly improved output ratios.

In the forest products industry, density has gone up only 6%. The most significant finding from the interviews in this sector was that the industry has huge amounts of inventoried land. The vast majority of industrial land in the Lower Mainland purchased by this industry was bought many years ago when prices were extremely low. Companies are now sitting on huge parcels of industrial land. The industry has seen very little increase (4%) in total industrial land required in the GVRD. The major companies have not bought any additional land, and increases are only due to some of the secondary wood products manufacturers increasing their requirements. The major producers are convinced that virtually no incremental land will be needed by them in the Lower Mainland over the coming 20 years. To a large extent, this is due to still large inventory holdings. Additionally, and to be discussed more fully in the section on location, respondents indicated that given the current land prices and other factors impacting location decisions in the Lower Mainland, there would be no major additions to capacity in the Lower Mainland during this time period.

REGIONAL LOCATION

1. Given Total Provincial Output, Industrial Land Requirements in a Region are a Function of Output Share for the Region.

2. Nine Basic Factors Were Identified Which Influenced Decision-Makers on Where to Locate.

3. The Importance of Each of the Factors Varies Across Industry Sectors as a Function of Industry Structure.

4. Each of the B.C. Regions Scores Differently on Each Factor, and Given Relative Importance Weightings of Factors by Industries, the Relative Attractiveness of the Regions Fluctuates.

5. Region Shares of Output Have Been Changing Over Time in Response to Regions' Relative Attractiveness.

Finally, the other manufacturing sector actually saw a decline in density over the five years. There has been some improvement in technology in this sector, and general sensitivity to price has meant a reduction in inventory holdings. However, by far the most significant factor explaining declining density is that the industry overall suffered a net decline in production over this period. This has happened at the same time that additional land has been purchased by this sector, resulting in the decline in density.

A general observation which is not surprising is that the industries achieving the greatest improvement in density are also those which have seen the most dramatic increase in real output. Since land is purchased in anticipation of future growth, more dramatic increases in output allow companies greater flexibility in passively reducing their inventories of unused land by "growing into it".

With this analysis of density in place, it is appropriate to examine regional location issues. Once that is done, the necessary building blocks will be available to examine trends in industrial land requirements.

B. REGIONAL LOCATION

This part of the report outlines study findings with regard to how companies determine where to locate production facilities within the province, and the emerging trends in this regard. As with the previous part, headings have been produced on the facing page for quick reference.

1. Given Total Provincial Output, Industrial Land Requirements in a Region are a Function of Output Share for the Region.

Since land requirements are linked to output, regional land

Table 6

OUTPUT BY REGION
MILLIONS OF $81

	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	TOTAL L. M.	REST OF B.C.	B.C. TOTAL
FOREST PROD.	1322	46	186	82	1636	5327	6963
METAL FABR.	1088	69	9	14	1180	1059	2239
CHEMICAL	1814	54	4	7	1876	460	2336
NON MET MIN.	252	9	3	7	271	167	438
FOOD & BEV.	1703	180	31	120	2034	568	2602
MISC MANUF.	1594	47	34	25	1700	90	1790
TOTAL	7773	405	267	252	8697	7671	16368

OUTPUT BY REGION
% SHARES OF TOTAL B.C. OUTPUT

	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	TOTAL L. M.	REST OF B.C.	B.C. TOTAL
FOREST PROD.	19	1	3	1	23	77	100
METAL FABR.	49	3	0	1	53	47	100
CHEMICAL	78	2	0	0	80	20	100
NON MET MIN.	58	2	1	2	62	38	100
FOOD & BEV.	65	7	1	5	78	22	100
MISC MANUF.	89	3	2	1	95	5	100
TOTAL	47	2	2	2	53	47	100

requirements are linked to the level of output within that region. In the context of the British Columbia economy, the important point to keep in mind is that each of the regions is competing for share of total provincial output.

Total industrial output in British Columbia is relatively independent of the location of that output within the province. In other words, the major forces impacting upon the British Columbia economy are external to the economy. The B.C. economy is primarily driven by a few key sectors which are export-focussed: forest products; mining; fisheries; international trade and transportation. These sectors respond to national and international economic conditions. Major changes to activity levels in these industries feed back into the secondary and tertiary industry sectors within the province, determining the overall level of activity. While the relationship between economic activity and the specific location of industrial capacity is circular, the feedback loop from location to overall activity is quite small. This hypothesis receives general support from most macro-economists who have studies the B.C. economy, and the study interview program generally confirmed this impression amongst industry executives.

This structure of the B.C. economy allowed the model to develop according to the three-stage process described in Section III. Specifically with regard to location, once total provincial output is determined, it is methodologically reasonable to allocate shares of provincial output to each of the regions in a top-down manner. Table 6 on the facing page provides detail on regional output in 1981, broken down by manufacturing industry. Not surprisingly, the data confirm a generally held perception that the GVRD accounts for by far the largest share of total provincial output of any region in the province. Each of the other three Lower Mainland regions is dwarfed by comparison to

the GVRD. They each account for roughly 2% of total provincial output, which translates into approximately 12% of total Lower Mainland output.

Although total output in each of the less industrialized Lower Mainland regions is roughly equal, the industrial mix within the regions is substantially different. Central Fraser has a relatively diversified industrial base. A notable exception to this is that Central Fraser has caputured a very large share of B.C. output in the food industry, and this translates into 44% of the industrial activity within the region.

Dewdney Alouette is much more heavily concentrated in one industry sector. The forest products industry accounts for a full 70% of output in the region which is much higher than that industry's share of the provincial total (at 42%). There is some food processing and some other manufacturing, and the other three industry sectors account for a combined total of 5% of the region output.

Fraser Cheam has an output mix which is relatively more diversified. However, in this region output in the metal fabrication industry and chemical industry is relatively inconsequential.

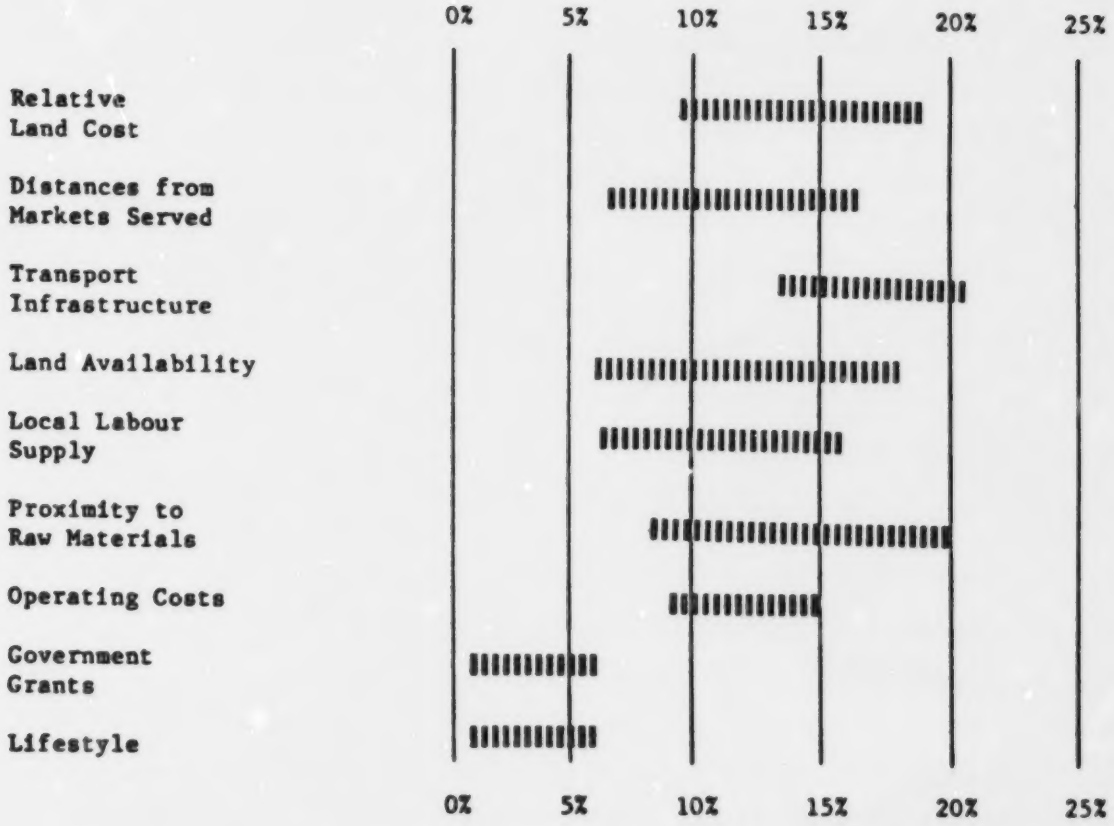
When the Lower Mainland is taken as a single large region, it is possible to discern some strong differences in concentration of activity by industry sector as compared to provincial totals. The Lower Mainland accounts for 78% of the food processing in the province, 80% of chemical output, and a full 95% of other manufacturing. At the opposite end of the spectrum, the Lower Mainland accounts for only 23% of total forest products output. This is also the only industry sector in which the Lower Mainland accounts for less than 50% of total provincial output.

Chart 3

RELATIVE IMPORTANCE OF FACTORS

IN EXPLAINING LOCATION

(RANGE OF RESPONSES ACROSS INDUSTRY SECTORS)



The next segment of this section presents the study findings on which factors are generally important in determining location decisions. The segment following that describes how each of these factors varies in importance across industry sectors. The subsequent segment discusses the relative attractiveness of each region for each industry sector. With this analytical backdrop, the final segment of this section describes how and why regions' shares have changed over the last five years in different industry sectors.

2. Nine Basic Factors were Identified which Influenced Decision-Makers on Where to Locate.

The interview process established nine basic factors which were considered important in determining where a company will locate a facility within the province. These are:

- relative land costs,
- distance from markets served,
- transportation infrastructure,
- land availability,
- local labour supply,
- proximity to raw materials,
- operating costs,
- government grants,
- lifestyle.

Chart 3 on the opposite page presents the range of responses to the relative importance of each factor for all of the industry sectors.

Other things being equal, companies would obviously prefer to locate where land is cheaper. Relative land costs received an importance ranking from a low of 9% for one industry to a high of 18%. This factor and operating costs are the only two location factors which simultaneously impact upon amount of land consumed. In the case of operating costs, however, the relative importance of this factor in explaining location spans a tighter range, from 9% to 15%.

The factor which was identified as generally being the most important of all was the adequacy of the transportation infrastructure within a region. Depending on the industry sector and even the specific company being interviewed, transportation infrastructure relates to any or all of deep-sea transportation, roads, and railway.

Discussions on transportation infrastructure were closely tied to two other factors: distance from markets served; and proximity to raw materials. The transportation infrastructure is obvisouly needed both to distribute the product to the buyer, and to bring raw materials to the production site. Proximity to raw materials received marginally higher marks than did distance from markets served. The former ranged in relative importance score from 8% to 20%, with the latter ranging from 7% to 17%.

Land availability received relatively high marks, ranging from 10% to 18%, with one outlier at 6%. When speaking of land availability, most respondents were talking about whether or not a reasonable choice of suitable parcels of land could be found within the region on which to build. Second, some respondents were referring to their perceptions on whether or not further expansion within the region was likely to be hampered by non-availability of land at some time in the future. Interestingly, the chemical industry ranked this factor at 6%, primarily reflecting the point that, once a site is chosen, further issues of land availability become very unimportant.

Local labour supply received marks from 7% to 16%. Most respondents indicated that this factor would receive much higher marks if the company was forced to consider locating in a very low population area, but given that they are anywhere at all in the Lower Mainland, or close to a "reasonable sized" city elsewhere in the province, this factor becomes somewhat less important.

The government grants factor received very low marks, ranging from 1% to 6%. The term government grants is perhaps a misnomer, but serves as the best short heading to capture the general comments received during the interviews. Most respondents indicated that to the extent that the issue of government support centred around a one-time cash incentive or ongoing incentives, these were wrapped into the general consideration of both relative land costs and/or relative operating costs of a region. To that extent, the two catagories of land cost and operating costs can capture some impact from government grants. Respondents also discussed the issue of other types of government support. In a general context, this can be most easily described as the questions of regional and municipal government attitude to business. Most comments in this regard were unfavourable towards government at all levels. The low importance ranking was described as "it's lousy all over, so it doesn't really affect us much".

Finally, lifestyle received relative importance waitings from 1% to 6%. Interview respondents indicated that lifestyle certainly played some role in determining where to locate a facility, but that by and large this factor received considertion only when other more basic conditions were satisfied.

Table 7

RELATIVE IMPORTANCE (%) OF FACTORS IN EXPLAINING LOCATION

	Forest Prod.	Metal Fabr.	Chem.	Non-Met Min.	Food & Bev.	Misc. Manuf.	Wholsl Trade
Relative Land Cost	18	17	9	12	13	12	16
Distances from Markets Served	7	8	17	11	15	15	15
Transport Infrastructure	18	14	19	18	12	16	21
Land Availability	17	18	6	15	12	10	17
Local Labour Supply	9	15	7	12	14	16	9
Proximity to Raw Materials	11	8	20	17	14	9	1
Operating Costs	9	11	15	12	12	11	14
Government Grants	6	3	4	1	4	5	6
Lifestyle	5	6	3	2	4	6	1
	100	100	100	100	100	100	100

3. The Importance of Each of the Factors Varies across Industry Sectors as a Function of Industry Structure

As can be seen from Table 7, there is some dispersion in the absolute importance and the relative importance of each of the nine factors within different industries. This section briefly discusses each industry sector in terms of which factors are most important and the reasons therefore.

The forest products industry identified three key factors in determining their location decision: transportation infrastructure; land cost; and land availability. Transportation infrastructure was rated as the most important of the three. Both rail and water transportation were cited, but companies with operations in the interior of B.C. felt that a good system of rail and road transportation eliminated the need for a coastal site. With regard to relative land costs, this factor is far more important in determining where to locate and once that decision had been made, has much less impact on the amount of land to buy. A number of companies cited the growing need for additional dry log storage as an important trend requiring additional land availability. Industry respondents ranked distance from markets served lower on the importance scale than did any of the other industry groups. This response is heavily weighted toward the major sawmills and paper manufacturers, who feel that when serving the international markets, any location in B.C. is roughly equivalent with regard to distance from markets served. Smaller wood products manufacturers producing higher value added items for local consumption in the Lower Mainland rated this factor more importantly.

The chemical industry gave highest marks to three interrelated categories: transportation infrastructure; proximity to raw materials; and distance from markets served. The major chemical manufacturers in B.C. are hydrocarbon based, and proximity to a

pipeline system is considered imperative. Distance from markets served received exceptionally high marks from respondents in the refining business, since liquid fuels are relatively costly to transport on a per unit basis. Relative land cost and land availability received very low marks when compared to other industries (9% and 6% respectively). Since proximity to both raw materials and served markets are so important, a site is only acceptable if it satisfies basic criteria in that regard, and at that point companies are willing to pay virtually any price for land in the proper location. Also, respondents indicated that given the capital intensity of the industry, land costs represent a very small percentage of total costs, which further explains the industry's price insensitivity with regard to land.

The food industry identified a number of factors all of equal importance, none of which dominated their decision structure. Each of the factors, excluding government grants and lifestyle, received an importance waiting between 10 and 15 percent. Within this narrow range, proximity to end markets received the highest marks at 15%. Proximity to raw materials received a 14% weighting, which in the case of the fish packers, means situating the plant on a site with deep-sea docking facilities. For agricultural food processors, location within the principal farming areas is essential.

The non-metallic minerals industry ranked proximity to raw materials and transportation infrastructure as the two most important factors. The cement and concrete products manufacturers felt that situating on or next to a source of raw materials was crucial. Also, since final products (especially cement) do not travel all that well, an excellent transportation infrastructure is important. Respondents in this industry stated that government grants have no influence on their location decision.

The metal fabrication industry ranked relative land cost and land availability as the two most important factors. There is some flexibility in reducing land inventory in response to high land costs, but relocation costs in this sector are so high that even at high land costs, companies will insist on maintaining space for future expansion. Consequently, land price serves more as a determinant of where to locate rather than influencing the amount of land to purchase. A number of respondents felt that zoning for heavy industrial use, and the perception that local governments would continue to support this kind of use for their industrial land was very important. This is reflected in the high importance placed on land availability, where "land availability" in this case refers to government control of whether and how much land will be made available to this industry sector.

The wholesale trade industry ranked transportation infrastructure as the key factor for their location decision at 21%. This industry sector is specifically in the business of moving product between manufacturer and purchaser, so this high weighting is no surprise. For the same reasons, the industry ranked proximity to markets as being important. Relative land costs and land availability each received high marks as well. Land costs make up a large percentage of total capital costs for a wholesale trade operation, hence a sensitivity to land price. Proximity to raw materials was considered a relatively meaningless concept to respondents in this industry, and they therefore gave this factor a 1% weighting.

4. <u>Each of the B.C. Regions scores Differently on each Factor, and Given Relative Importance Weightings of Factors by Industries, the Relative Attractiveness of the Regions Fluctuates</u>

For the most part, the interview results regarding the current conditions of the various factors influencing location in each of the regions were independent of the industry in which the

Table 8

1982 AVERAGE CONDITION SCORES ACROSS ALL INDUSTRIES
(0 = UNACCEPTABLE 10 = EXCELLENT)

	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.
Relative Land Cost	5	8	8	8	8
Distance from Markets Served	8	6	4	2	0-8
Transport Infrastructure	8	8	2	3	4-7
Land Availability	5	7	7	6	6-9
Local Labour Supply	7	7	6	4	5
Proximity to Raw Materials	8	6	4	3	5
Operating Costs	5	6	6	6	5-8
Government Grants	1	1	3	4	7
Lifestyle	8	6	6	4	4-8

interview respondent operates. That is to say, current condition ratings across regions seemed to be fairly homogeneous across industry groups. This section will first describe the ratings given to each region very briefly, and then discuss how these impact each of the industry groups as a function of the relative importance of the factors within each industry. Table 8 on the facing page portrays the average ranking of the various conditions for each of the regions. It is important to note that this chart portrays the aggregate averages, and there are certainly outlier ratings by some industries for some factors. These will be noted in the subsequent discussion on industry sectors.

The GVRD received extremely homogeneous factor ratings across all industry sectors. Land costs are very close to the unacceptable level, but the region is best situated with regard to distance from markets served, transportation infrastructure, availability of local labour, proximity to raw materials, and lifestyle. While other factors may show a wider range of scores across regions, the difference in ratings of relative land costs between GVRD and all of the other regions is perhaps the most dramatic result showing up on the chart.

The Central Fraser region also received very consistent rankings across industry sectors. The region performs well in virtually every category save for government grants. It ranks first or second in every single category.

The score for Dewdney Alouette showed some greater variation across industries, however there was only one major outlier: the non-metallic minerals industry ranked the transportation infrastructure for the region significantly higher than did the other industry sectors. The region performs reasonably well in terms of relative land costs, land availability, labour supply, operating costs, and lifestyle. However, the region performs

Table 9

REGION ATTRACTIVENESS SCORES
(0 = UNACCEPTABLE 10 = EXCELLENT)

	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.
Forest Prod.	5.7	5.2	3.0	1.1	6.5
Metal Fabr.	6.0	6.5	2.0	1.5	4.6
Chemicals	8.0	2.0	1.0	1.0	6.0
Non-Met. Min.	7.0	7.5	5.0	4.0	1.0
Food & Bev.	4.3	8.7	2.3	3.1	1.0
Misc. Manuf	8.3	5.3	2.4	1.0	4.3
Wholsl Trade	8.0	5.0	2.0	1.0	5.0

quite poorly in terms of distance from markets served, and transportation infrastructure, and only moderately better in terms of proximity to raw materials. Of particular note, respondents indicated that the fact that the region was on the north side of the Fraser River with limited bridge access to the major transportation arteries was a problem.

Fraser Cheam received reasonably consistent marks across all factors. The region scores well on relative land costs, but performs in worst position on every other factor save for land availability and transportantion infrastructure, where it ranks second from bottom.

The Rest of B.C. region had the greatest dispersion of responses across industries. The "region" is extremely large, and interview responses are therefore less consistent in some cases. The table shows point values where the industry averages were fairly consistent, and a range of responses where the answers were not reasonably well clustered. The region scores very well on relative land costs, land availability, operating costs, and government grants. It performs less well in terms of transportation infrastructure, local labour supply, and proximity to raw materials. The widest dispersion in responses was for distance from markets served for this region. Depending on the industry sector, the rest of B.C. ranked anywhere from the best to worst region.

Given the relative importance weightings of the factors for each industry and their relative condition in each region, it is possible to establish some meaningful patterns based on the interview responses to overall region attractiveness ratings.

Table 9 on the facing page gives the overall region scores for each industry sector for each region. In general, GVRD and Central Fraser come out with highest scores, the rest of B.C.

ranks in the middle range, and Dewdney Alouette and Fraser Cheam have bottom spots.

In the forest products industry, outside the Lower Mainland receives top marks, followed closely by GVRD and Central Fraser. Outside the Lower Mainland takes top spot based on having the best relative land costs, land availability, and operating costs of any region as rated by this industry sector. GVRD and Central Fraser take strong second positions based to a large extent on high marks for transportation infrastructure and land availability. In the case of land availability, GVRD is ranked poorly, but this is countered by the fact that the amount of land currently held in inventory by this industry is more than enough to meet expansion needs.

The chemical industry gives GVRD undisputed top position, followed by the rest of B.C. The other three regions are all close to the unacceptable mark. GVRD receives its top marks based on its superior position in terms of distance from markets served, transportation infrastructure and proximity to raw materials, all of which are the most important factors determining location for this industry. The rest of B.C. receives marks as high as it does partly due to anticipation of the pipeline to be built to Prince Rupert.

The metal fabrication industry ranks Central Fraser as the superior region, followed closely by GVRD and the rest of B.C. However, region scores overall are relatively low for this industry sector. High importance placed on relative land costs and land availability in this industry explained why GVRD falls from top position, even though it ranks well on most other factors.

The non-metallic minerals industry ranks GVRD and Central Fraser fairly closely followed by Dewdney Alouette and Fraser Cheam,

with the rest of the province coming in a distant last. Relative to other regions, this industry ranked the Rest of B.C. in bottom or second to bottom position on transportation infrastructure, proximity to raw materials and distance from markets served, the first two of which are the most important factors for the industry.

The food industry ranks Central Fraser significantly out in front, with each of the other Lower Mainland regions fairly closely clustered together. The Rest of B.C. ranks in bottom position. This is primarily explained by the Lower Mainland's proximity to the major markets served, Central Fraser's position in the Lower Mainland farming area, and GVRD's position relative to the Fraser River fisheries. GVRD ranks poorly compared to Central Fraser primarily due to major differences in relative land costs.

The other manufacturing sector ranks GVRD in top position, followed by Central Fraser and outside the Lower Mainland in the middle spots. GVRD takes top position based on its high marks for transportation infrastructure, proximity to raw materials, lifestyle, and distance from markets served. The industry ranks Central Fraser and the rest of B.C. almost identically on every location factor, and generally tied for first or second position relative to other regions.

Finally, wholesale trade shows the most dramatic disparity between scores for the Lower Mainland regions, with GVRD significantly better ranked than any of the other three regions. This industry consistently ranked GVRD in top spot on every factor save for relative land costs. Most important, this industry scores transportation infrastructue, which receives the highest importance waiting of all the factors, significantly better for the GVRD than for every one of the other regions.

Table 10

REGION'S SHARES BY INDUSTRY OF TOTAL B.C. OUTPUT (%)

	GVRD		C FRASER VALLEY		DEWDNEY ALOUETTE		FRASER CHEAM		TOTAL L.M.		REST OF B.C.		B.C. TOTAL	
	76	81	76	81	76	81	76	81	76	81	76	81	76	81
FOREST PROD.	19	19	0	1	2	3	1	1	20	24	79	76	100	100
METAL FABR.	53	49	1	3	0	0	0	1	55	53	45	47	100	100
CHEMICAL	55	77	1	2	0	0	0	0	56	80	44	20	100	100
NON MET MIN.	39	58	4	2	0	1	1	2	45	62	55	38	100	100
FOOD & BEV.	59	66	5	7	1	1	4	5	69	78	31	22	100	100
MISC MANUF	91	89	2	3	1	2	1	1	96	95	4	5	100	100
WHOLSL TRADE	54	56	2	3	1	2	1	2	58	62	42	38	100	100

5. Region Shares of Output have been Changing over Time in Response to Regions' Relative Attractiveness

Output shares fluctuate in response to region attractiveness scores. However, this does not automatically mean that the region with the highest score will continue to gain share in relation to the rest of the province. If a region already has a significant share of total output, some deterioration in the relative attractiveness of that region, even if it remains in top spot, can trigger a loss of market share for the region. That is to say, region shares will fluctuate to a certain extent in direct correlation to the absolute region attractiveness of a region, but also as an adjustment of current shares to more adequately reflect the spread on relative attractiveness scores between regions. Table 10 on the facing page provides information on output share by region by industry.

GVRD has gained five share points in the last five years in the manufacturing sector. The region has gained significant share in the chemical industry and non-metallic minerals. In both of these sectors, GVRD receives high region attractiveness marks. The region has also improved market share in food processing by six points, where it receives second highest score on region attractiveness. In forestry, the region has improved its share marginally, and this can be seen as an adjustment in share towards reflecting the fact that the rest of B.C. has an inordinately high market share (77%) compared to the rather small advantage it is showing in region attractiveness. For similar reasons, GVRD is losing share slowly in other manufacturing: to adjust for the fact that the difference in regional attractiveness scores is not sufficient to justify GVRD's absolute dominance with 89% of the provincial output in this sector.

Central Fraser has increased its overall share of manufacturing output by almost one full percentage point. This reflects significant gains in food processing and metal fabrication where it receives top marks. Those gains are partially offset by a significant loss of market share in non-metallic minerals. This loss of share in non-metallic minerals is somewhat curious, in that the region ranks in top attractiveness position according to interview results. One can only expect that this loss of share will stabilize or reverse in the future. On the other hand, given that the output only represents 2% of total region output, this decline in share is not alarming from the overall perspective of region development.

Dewdney Alouette has improved its share of total output by one half percent, from 1% to 1.5%. The region has seen an increase in share in wood products and other manufacturing, and marginal improvement in non-metallic minerals. Overall, the region has a low share of total output, reflecting its low rankings across all industry sectors. However, it has achieved modest growth to account for the fact that disparity in attractiveness scores across regions is not sufficient to restrict the region to 1% of total provincial output.

Fraser Cheam has fared slightly better than Dewdney Alouette, but not so well as Central Fraser. The region has increased its share of total B.C. output by approximately one half percent, but lost its position as the second largest producer in the Lower Mainland in 1976 to Central Fraser by 1981. The region has seen increase in share across virtually all industry sectors. As with Dewdney Alouette, this is probably a stock adjustment moving the region towards a level which more fairly reflects its relative attractiveness position as compared to other Lower Mainland regions.

Table 11

LAND REQUIREMENTS BY REGION IN ACRES

1982

	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	TOTAL L. M.
FOREST PROD.	1943	161	266	137	2507
METAL FABR.	1210	73	9	14	1306
CHEMICAL	1912	54	4	132	2102
NON MET MIN.	522	86	26	67	701
FOOD & BEV.	649	138	14	53	854
MISC MANUF.	972	61	25	21	1079
WHOLSL TRADE	2502	254	14	36	2806
TOTAL	9710	827	358	460	11355

LAND REQUIREMENTS BY REGION % SHARE OF REGION TOTALS

	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	TOTAL L. M.
FOREST PROD.	20	19	74	30	22
METAL FABR.	12	9	3	3	12
CHEMICAL	20	7	1	29	19
NON MET MIN.	5	10	7	15	6
FOOD & BEV.	7	17	4	12	8
MISC MANUF.	10	7	7	5	10
WHOLSL TRADE	26	31	4	8	25
TOTAL	100	100	100	100	100

The only region to lose share on an aggregate basis over the last five years is the rest of B.C. Its share has dropped rather dramatically from 55% to to 47% of total. The region has lost share to the Lower Mainland in every industry sector except metal fabrication, where it gained three points, and other manufacturing, where it gained one point. In fact, in four industry sectors, the region suffered an absolute decline in output. The region is slowly losing share in wood products, where although it holds the pre-eminent position, the other regions fare better in terms of attractiveness than the current output distribution would suggest. The region ranks at the bottom of the scale in food processing, and this explains its drop of nine share points over the five years. In the chemical industry, the region dropped 22 share points, essentially all to the GVRD. In the short term, this trend is likely to continue, but the completion of the gas pipeline to Prince Rupert and the proposed petro-chemical facilities in the region will ultimately reverse this trend. Non-metallic minerals has also dropped sixteen share points, again explained by the region's dismal attractiveness rating compared to other regions.

With the two pieces of analysis now in place, regarding trends in density changes and trends in output shares, it is possible to examine emerging trends in industrial land requirements by industry and by region.

C. LAND REQUIREMENTS BY REGION

Industrial land requirements are a function of the overall level of output, density trends, and changes in output by industry sector. Table 11 on the facing page presents data on industrial land broken down by six manufacturing sectors and the wholesale trade sector (which have been modelled on a density / share-of-output basis), for each of the Lower Mainland regions in 1981.

The other three sectors forecasted in this study (major transportation, other transportation, and utilities) are discussed in a historical context as well as a forecast context in Section V of this report. Consequently, the percentages used in the remainder of this section are expressed in terms of percentages of the total of the seven "modelled" sector, as opposed to the overall region totals.

The GVRD clearly has the largest amount of industrial land in use of any of the regions. Forestry and chemicals are the two largest users of industrial land in the region, reflecting their high share of regional output. Other manufacturing output comprises 20% of region total output, but given relatively high density factors, accounts for only 10% of total land requirements. An even more dramatic example of an industry where high density factors offset high total output is the food industry, representing 22% of total output, but only 7% of total land requirements.

The major user of industrial land in Central Fraser is wholesale trade, which makes up almost 1/3 of total land requirements. In the manufacturing sector, the major users are wood products and food processing. The density factor for food processing in Central Fraser is not as high as GVRD, but even so, a 44% share of total region output in this sector still only represents 17% of total land requirements. Wood products, on the other hand, with only 11% share of total region output accounts for almost 19% of land requirements, explained by a very low density factor for this industry sector in this region.

In Dewdney Alouette, the forestry industry is by far the largest user of industrial land, accounting for approximately 75% of the total. This is explained by the fact that forestry accounts for a full 70% of the total output in the region. Other manufacturing and non-metallic minerals each account for approximately 7% of total land requirement. In the case of other manufacturing, this is due to the

fact that this sector accounts for 13% of total region output, whereas in the case of non-metallic minerals, the large land requirements are a reflection of extremely low density factors for this sector.

In Fraser Cheam, forestry, chemicals, and non-metallic minerals account for the largest chunk of industrial land. The large share of land used by the non-metallic minerals industry is again a reflection of very low density factors. In the case of forestry, the land requirements are a closer reflection of output share. The large amount of land used by the chemical industry is due to the existence of an explosives plant which has a significant amount of buffer space surrounding the factory. At the other extreme, food processing, which accounts for 33% of total regional output, accounts for only 8% of land requirements given the high density factors generally observed in this industry sector.

The preceeding analysis identifies key emerging trends in the output to land ratios, market shares, and overall land requirements by industry and region in the province. This sets the stage for developing long term forecasts for land requirements through the year 2001, and each of the key determinants impacting the forecast.

V. FORECAST OF DEMAND FOR INDUSTRIAL LAND TO 2001

In summary, the outlook for industrial land demand in the Lower Mainland can be captured in the following six points:

- The rate of change in density is expected to slow from the high rates achieved in the late 1970's. This has a moderating effect on the total forecast for industrial land. The most significant explanatory factor in the slowdown in density changes comes about as a result of forecasts for lower interest costs than observed in the recent past. Additionally, a slightly lower rate of technological change and substitution of capital for labour in the early years contributes to this slowdown.

- The major results of the regional output analysis shows that the GVRD will gradually lose share of total B.C. output in manufacturing, as will the area of the province outside the Lower Mainland. In other words, Central Fraser, Dewdney Alouette, and Fraser Cheam are each picking up an increasing percentage share of total B.C. output in the manufacturing sector. While each of the five regions modelled is increasing its level of attractiveness as compared to its own 1981 base levels, each of the three regions gaining share of output are increasing their attractiveness at a faster rate than are the GVRD or the rest of B.C. This fact, combined with historically observed "momentum" changes in region shares of output combined to produce the noted shifts in production shares.

- Given the province-wide forecasts for economic activity, even industries in regions losing share are forecasted to grow in absolute terms in all cases, but obviously at slower rates than regions gaining share.

- In the case of the three industry sectors modelled directly on a rate of growth in land demand, the major findings from the industry interview program are that each of these sectors will show

substantially lower rates of growth in land demand than have been observed historically. In total, these three sectors require a total of approximately 1,200 net new acres throughout the entire Lower Mainland by 2001. This is a substantially slower rate of growth than exhibited by the manufacturing sector or the wholesale trade sector, and consequently these sectors account for a lower share of total regional industrial land required in each of the Lower Mainland regions by the end of the forecast horizon than they do in 1981.

- In terms of total land requirements by region, the forecast suggests a total increase in net industrial land (i.e. exclusive of land requirements for infrastructure) in the Lower Mainland of 6,600 acres over the 20-year period. This translates in to an average annual increase of 320 acres per year, but most of this growth is centered in the second half of the forecast. Additionally, the major swings in rates of increase over the forecast horizon are experienced in the GVRD.

- With regard to forecast sensitivity to alternative economic scenarios, a lower economic growth scenario produces a greater net change in land requirements on the down side than does a higher economic growth scenario on the up-side.

- A senario showing no change in region factor scores from 1981 levels was developed for benchmark purposes. It suggests that the forecast is extremely sensitive to factor changes which affect density. In particular, if the level of relief expected in the base forecast does not come to pass with regard to interest rates and easing of land costs in the early years of the forecast, density change will be greater, resulting in lower rates of increase in total land requirements in the Lower Mainland.

In final summary, a major conclusion reached by the study team with regard to the forecast for industrial land demand in the Lower Mainland is that the forecasts presented here are, if anything, more likely to overstate the demand for industrial land than to understate it. This

conclusion is reached partly as a result of the alternative scenarios which have been reported in this section, supplemented by a number of other alternative scenarios which have been generated.

There is a second reason for stating that the forecasts are more likely to overstate the future demand for industrial land than understate it. Specifically, during the model construction phase of this study, the study team had to develop "momemtum" forecasts for density change and region output share change which reflected both the historical data observed and the findings generated through the extensive interview program. In almost every case where the momemtum coefficients used in the model differ from the historical rates (to reflect industry interview findings), the values used in the model show lower density changes than those historically observed. In other words, the forecast is not only subject to the risk that the relief in interest rates and land costs will not come to pass, but additionally, that if anything, the momentum density changes may understate the rate at which industry will more efficiently and intensively use land, and this would again imply a reduced demand for industrial land in the coming 20 years.

The following six parts of this chapter present the assumptions and forecast values for the land forecast in more detail, and a discussion of the alternative scenarios.

A. B.C. ECONOMIC FORECAST

The output forecast necessary to drive the land demand model has been supplied by the Central Statistics Bureau (CSB), Ministry of Industry & Small Business Development. CSB provides a series of scenarios for the long term economic outlook for British Columbia. These scenarios have just recently been made available for use within the provincial government. The forecasts were accessed to obtain the required output forecasts by industry to 2001. The scenario chosen for the base case forecast in this study is the one which the study team considers

Table 12

OUTPUT - ASSUMPTIONS
ANNUAL GROWTH RATES IN %

INDUSTRY	'81 BASE	'81-'86	'86-'91	'91-'96	'96-'81
FOREST PROD.	6963	1.81	2.18	3.77	1.29
METAL FABR.	2239	0.93	2.66	7.18	3.80
CHEMICAL	2356	0.85	1.96	4.37	2.63
NON MET MIN.	438	1.31	2.41	4.91	3.02
FOOD & BEV.	2602	0.63	2.19	4.40	2.60
MISC MANUF	1798	2.10	2.79	6.80	4.80
WHOLSL TRADE	10400	1.98	3.52	5.18	5.03
TOTAL	34788				

most probable. Forecast values for industry growth from this scenario are shown in Table 12 on the facing page.

The scenario is based on the assumption of gradual normalization from the deep cyclical downturn of 1982 towards more stable growth in the 1990's. Implicit is the assumption of partial success in containing inflation in the 198C's through monetary policy. Higher productivity growth in the 1990's contributes to more stable prices and less fluctuations in these years. The CSB has titled this scenario "Partial Disinflation".

Despite a gradual normalization, there are two built-in small cycles in the 1980's. These cycles coincide with presidential election years in the United States. In other words, cyclical upturns occur in 1984-85 and 1988-89. These cycles reflect the assumption of partial containment of inflation in the 1980's via monetary restraint, which, nevertheless, is punctuated by relaxation to stimulate growth during U.S. election years. Characteristically, B.C.'s economy moves in phase with U.S. monetary policy and U.S. economic growth. Thus, in the 1980's, B.C.'s economy is characterized by two short spurts of growth overlayed on the remaining years of rather weak growth.

In the 1990's, the results of over a decade of adjustment towards lower inflation begin to emerge. In addition, the labour force will have matured, and the dissemination of technological change in the 1980's will have favourably altered the scocio-economic environment. All these factors lead to higher productivity growth and more stablility in the economy. The economy moves closer to its potential with higher growth and witnesses less short-term fluctuations in the 1990's. By the end of the forecast, the growth rate of the economy begins to slow.

The individual industry sectors are embedded in the overall economy and thus the scenario described roughly matches the outlooks of each

of the industry sectors. However, some sectors have specific trends which deviate slightly from that of the overall economy. This is specifically true of the wood sector. This sector will typically be more accentuated in its fluctuations. Also, in the 1990's, the decline in growth rates will be more pronounced as a result of both a slowing in the growth of demand for wood and also in the supply of timber. The primary metal sector also shows some of the volatility of the wood sector, since a large portion of the primary metal sector caters to the wood and other extractive and primary manufacturing industries. Typically, the food and beverage and miscellaneous manufacturing sectors are more stable.

Although there is a great deal of uncertainty concerning the economy and the way in which it is expected to unfold in the coming years after the current severe recession, this partial disinflation scenario depicts a middle-of-the-road outlook. In this sense, it is a reasonable scenario for the base line forecast developed in this study.

B. DENSITY FORECASTS

This part of the report describes the forecast assumptions made for the six factor conditions which affect density change, and the resulting forecast for density change by industry and region.

As discussed in Section III of this report and in more detail in Sections II and III of the Technical Report, the forecasting model is built on a "momentum change" basis. In other words, both density and region output share are assumed to change over time at a momentum rate unless changes are made in assumptions regarding regional condition factors. In the context of the model, then, if a regional factor score is left unchanged, it implies that the force exerted by this factor on density and/or region share will be of the same magnitude as the force exerted from 1976 through 1981.

Table 13

DENSITY MODULE

DATA SECTION

COMMON DENSITY FACTORS:

	INDEX VALUES 1981-86	1986-91	1991-96	1996-2001
INT. COST	1.30	1.30	1.30	1.30
TECH. CHANGE	0.95	0.95	0.95	0.95
CAP. SUBST'N	0.95	0.95	1.00	1.00
GROSS UP	1.00	1.00	1.00	1.00

REGION-SPECIFIC DENSITY FACTORS:

LAND PRICE				
GVRD	1.15	1.10	1.05	1.05
E FRASER VAL	1.15	1.00	0.95	0.95
DEWDNEY AL.	1.15	1.00	0.95	0.95
FRASER CHEAM	1.15	1.00	0.95	0.95
PROPERTY TAX				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00

1. Input Assumptions

Table 13 on the facing page provides details on the factor scores which have been input into the model. The discussion immediately following describes the reasoning behind these assumptions.

- Interest costs have been assumed to moderate rather significantly from the recent high rates, running at a long term average of approximately 10% to 12%. Keeping in mind that an index score greater than 1.0 implies an improvement in a factor condition, this index has been set at 1.3.

- Interview respondents indicated in almost every instance that they expected the rate of technological change to abate somewhat in terms of its impact on land requirements, and consequently the index was reduced below 1.0.

- The rate of substitution of capital for labour is assumed to slow in the first decade of the forecast. This is primarily a function of the sluggish economic performance anticipated over the decade. Significant capacity under-utilization, coupled with reduced capital spending programs implies a lower rate of investment in new capital equipment.

- Land prices in the GVRD are assumed to increase at a slower pace than was observed in the dramatic speculative period of the late 70's and early 80's. The most recent year of history bears witness to this. Inspection of the table shows the improvement in the GVRD land price factor to be most significant in the early years of the forecast, with rates of increase gradually building up in the 1990's as land becomes more scarce and economic activity picks up. Land prices for the other three regions are also assumed to increase at more moderate rates in the first five years of the forecast, but given the fairly significant increases in land demands (on a

percentage basis) for each of these regions, by 1990 the rate of increase is assumed to surpass the base level, and hence the deterioration in the land price index for those regions in the 1990's.

- Gross-up factors and property taxes are both factors under direct control of local governments. This study made no attempt to develop forecasts for future government policy, and for this reason factor values were left at the base index value of 1.0.

2. Density Forecasts

The combined impact of the forecast assumptions which have been noted is generally to reduce the rate of increase of density growth throughout the forecast horizon. Since density is expressed as millions of dollars of output per acre, a lower density factor (all other things being equal) implies a greater demand for land. Or, a slowdown in the rate of increase of the density factors as compared with the 1976-81 period implies greater demand for land per unit of increase in output than would have otherwise been the case.

The most dramatic impact on density results from the assumptions on interest costs. Since this factor is universal across all regions and industry sectors, it's effect is pervasive.

Land purchase costs also explain a significant amount of the reduction in the momentum rates of change in density. In the GVRD, lower rates of land price increases over the entire forecast horizon mean that density changes are moderated throughout the forecast: more moderate price increases provide less stimulus to management to conserve land. In the other Lower Mainland regions, improvement in land price increases in the early years of the forecast tend to slow down density increases,

Table 14

DENSITY RATIOS

	1981	1986	1991	1996	2001
C V A D					
FOREST PROD.	0.68	0.68	0.68	0.78	0.71
METAL FABR.	0.98	0.94	0.99	1.07	1.14
CHEMICAL	0.95	0.98	1.03	1.08	1.14
NON MET MIN.	0.48	0.54	0.62	0.71	0.83
FOOD & BEV.	2.62	2.79	2.99	3.26	3.47
MISC MANUF	1.64	1.65	1.68	1.73	1.81
WHOLSL TRADE	4.13	4.29	4.58	4.85	5.23
C FRASER VAL					
FOREST PROD.	0.29	0.29	0.30	0.31	0.33
METAL FABR.	0.95	0.99	1.07	1.18	1.26
CHEMICAL	1.00	1.04	1.10	1.18	1.27
NON MET MIN.	0.10	0.11	0.13	0.16	0.19
FOOD & BEV.	1.30	1.38	1.51	1.68	1.84
MISC MANUF	0.81	0.85	0.85	0.89	0.95
WHOLSL TRADE	2.02	2.10	2.25	2.48	2.72
DEWDNEY AL.					
FOREST PROD.	0.78	0.78	0.72	0.76	0.79
METAL FABR.	1.00	1.05	1.13	1.24	1.36
CHEMICAL	1.00	1.04	1.10	1.18	1.27
NON MET MIN.	0.12	0.14	0.16	0.19	0.22
FOOD & BEV.	2.21	2.35	2.57	2.86	3.13
MISC MANUF	1.36	1.37	1.42	1.49	1.59
WHOLSL TRADE	20.36	21.14	22.72	24.97	27.45
FRASER CHEAM					
FOREST PROD.	0.60	0.60	0.62	0.65	0.68
METAL FABR.	1.00	1.05	1.13	1.24	1.36
CHEMICAL	0.83	0.83	0.83	0.83	0.83
NON MET MIN.	0.10	0.11	0.13	0.16	0.19
FOOD & BEV.	2.26	2.40	2.63	2.93	3.20
MISC MANUF	1.19	1.20	1.24	1.31	1.39
WHOLSL TRADE	7.92	8.22	8.84	9.71	10.68

but deterioration in land prices in the later years then accelerate the rate of density change in those regions.

Changes in technology and substitution of capital for labour have been assumed to slow somewhat over the forecast, and again, since these factors apply across all industries and regions, they exert a small but pervasive influence across all of the density values.

Examining the data on a regional basis, some basic trends become evident. Forecast values are shown in Table 14 on the opposite page. The rate of increase in density in GVRD is slower than for the other regions, and the density increases for the later years of the forecast are greater than for the earlier years.

Part E of this section will discuss the total land requirements by industry and by region. However, prior to that discussion, an analysis of regional shares of output is necessary.

C. REGIONAL OUTPUT FORECASTS

As with the previous part of this report, this part is broken down into a brief discussion of input assumptions, followed by a discussion of the resulting shares.

1. Input Assumptions

Table 15 on the following facing page provides details of factor scores used in the base forecast.

- Land price values and property tax values are identical to those used in the Density Module.

- Factor scores for distance to market served are assumed to gradually increase for each of the Lower Mainland regions

Table 15

INDEX VALUES FOR REGION CONDITIONS

LAND PRICE	1981-86	1986-91	1991-96	1996-2001
GVRD	1.15	1.10	1.05	1.05
E FRASER VAL	1.15	1.00	0.95	0.95
BENDNEY AL.	1.15	1.00	0.95	0.95
FRASER CHEAM	1.15	1.00	0.95	0.95
REST OF B.C.	1.00	1.00	1.00	1.00
DIST TO MRKT				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.05	1.10
BENDNEY AL.	1.00	1.05	1.10	1.15
FRASER CHEAM	1.00	1.05	1.10	1.15
REST OF B.C.	1.00	1.05	1.10	1.15
TRNSPORTAT'N				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.00	1.00
BENDNEY AL.	1.00	1.10	1.20	1.25
FRASER CHEAM	1.00	1.10	1.20	1.25
REST OF B.C.	1.00	1.10	1.10	1.10
LAND AVAIL'Y				
GVRD	1.00	0.95	0.90	0.90
E FRASER VAL	1.00	1.00	0.95	0.90
BENDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00
LABOR SUPPLY				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.00	1.00
BENDNEY AL.	1.00	1.00	1.05	1.05
FRASER CHEAM	1.00	1.05	1.05	1.10
REST OF B.C.	1.00	1.05	1.05	1.10
H WAY ACCESS				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.00	1.00
BENDNEY AL.	1.00	1.00	1.05	1.10
FRASER CHEAM	1.00	1.00	1.05	1.10
REST OF B.C.	1.00	1.10	1.30	1.30
PROPERTY TAX				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.00	1.00
BENDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00
GOVT GRANTS				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.00	1.00
BENDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00
LIFESTYLE				
GVRD	1.00	1.00	1.00	1.00
E FRASER VAL	1.00	1.00	1.00	1.00
BENDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00

other than the GVRD. Essentially, this reflects a gradual shift (on a percentage basis) of population within the Lower Mainland to the outlying regions. Hence, a business situated in the outlying regions "moves" closer to the Lower Mainland market through population shifts. Similar reasoning concerning population growth in the rest of the province improves this factor score for the rest of B.C. also.

- The transportation infrastructure is assumed to increase gradually in both Dewdney Alouette and Fraser Cheam. As the regions become more populous, and more industry situates in these regions, it is assumed that highways, local traffic arteries, and railspurs will be upgraded accordingly.

- Land availability scores for GVRD and Central Fraser are assumed to deterioriate as more and more industrial land is taken up, and "ideal" sites are harder to come by.

- In line with shifts in population within the Lower Mainland, the local labour supply for Dewdney Alouette and Fraser Cheam is assumed to improve. These regions received somewhat lower base marks in this category than did Central Fraser and GVRD, and as more population moves up the valley, this condition should improve. The Rest of B.C. also receives higher marks for labour availability as population in other centers is expected to grow.

- Based to a large extent on an assumption of pipeline construction in the mid to late 1980's, the score for access to raw materials in the rest of B.C. is expected to improve fairly significantly in the 1990's. Scores for the outlying Lower Mainland regions are also expected to improve somewhat.

- The scores for government grants have not been changed over the forecast horizon. Again, this is because the study team

Table 16

REGIONAL SCORES

FOREST PROD.	1981	1986	1991	1996	2001
GVRD	5.78	5.85	5.91	5.86	5.82
C FRASER VAL	5.28	5.34	5.34	5.27	5.17
DEWDNEY AL.	3.08	3.08	3.15	3.29	3.49
FRASER CHEAM	1.10	1.13	1.16	1.21	1.29
REST OF B.C.	6.58	6.58	6.74	7.16	7.67
MEAN	4.30	4.38	4.46	4.56	4.69
METAL FABR.					
GVRD	6.08	6.15	6.28	6.14	6.08
C FRASER VAL	6.58	6.67	6.67	6.58	6.45
DEWDNEY AL.	2.08	2.05	2.09	2.17	2.29
FRASER CHEAM	1.58	1.54	1.58	1.64	1.74
REST OF B.C.	4.68	4.68	4.75	5.01	5.33
MEAN	4.12	4.20	4.26	4.31	4.38
CHEMICAL					
GVRD	0.08	0.11	0.16	0.14	0.13
C FRASER VAL	2.08	2.03	2.03	2.03	2.04
DEWDNEY AL.	1.08	1.01	1.04	1.11	1.21
FRASER CHEAM	1.08	1.01	1.04	1.11	1.22
REST OF B.C.	6.08	6.08	6.31	6.93	7.71
MEAN	3.68	3.63	3.72	3.87	4.06
NON MET MIN.					
GVRD	7.08	7.13	7.16	7.09	7.03
C FRASER VAL	7.58	7.64	7.64	7.57	7.50
DEWDNEY AL.	5.08	5.09	5.21	5.50	5.93
FRASER CHEAM	4.08	4.07	4.19	4.42	4.88
REST OF B.C.	1.08	1.08	1.05	1.14	1.25
MEAN	4.98	4.98	5.05	5.15	5.38
FOOD & BEV.					
GVRD	4.38	4.38	4.41	4.39	4.37
C FRASER VAL	8.78	8.87	8.87	8.83	8.79
DEWDNEY AL.	2.38	2.34	2.39	2.58	2.67
FRASER CHEAM	3.18	3.16	3.24	3.48	3.65
REST OF B.C.	1.08	1.08	1.04	1.12	1.22
MEAN	3.88	3.95	3.99	4.05	4.14
MISC MANUF					
GVRD	8.38	8.45	8.51	8.47	8.44
C FRASER VAL	5.38	5.48	5.48	5.38	5.37
DEWDNEY AL.	2.48	2.44	2.58	2.63	2.83
FRASER CHEAM	1.08	1.02	1.05	1.11	1.20
REST OF B.C.	4.38	4.38	4.47	4.77	5.16
MEAN	4.24	4.32	4.39	4.47	4.68
WHOLSL TRADE					
GVRD	8.08	8.19	8.25	8.18	8.11
C FRASER VAL	5.08	5.12	5.12	5.07	5.02
DEWDNEY AL.	2.08	2.05	2.11	2.22	2.38
FRASER CHEAM	1.08	1.02	1.06	1.11	1.28
REST OF B.C.	5.08	5.08	5.17	5.39	5.69
MEAN	4.28	4.28	4.34	4.48	4.48

has made no attempt to forecast changes in government policy over the forecast horizon.

- Relative scores for regional lifestyle have also not been changed.

2. Regional Output Shares

As described in detail in the Technical Report, regional factors for output shares are first translated into regional attractiveness scores, and subsequently into regional output shares. Consequently, this part of the report follows the same progression.

Regional attractiveness scores are generally increasing over the forecast horizon. The scores are given in Table 16 on the facing page.

Industry attractiveness scores are generally increasing across all regions and industries. However, given the discussion in Section III of this report outlining the difference in weightings placed by each industry on the various factors, it is not surprising that attractiveness scores are changing at different rates across industries. Also, given the selective improvement in some factors in only certain of the Lower Mainland regions, attractiveness scores are not increasing uniformly across all regions for any given industry sector.

The resulting scores are self-evident from inspection of the Table. A few of the major highlights resulting from these calculations are noted in the following points.

- The GVRD increases in attractiveness in all industries from 1981 through 1991, and in some cases through 1996. However, as other regions become relatively more attractive (given the

Table 17

REGION'S SHARES
OF TOTAL B.C. OUTPUT

FOREST PROD.	1981	1986	1991	1996	2001
GVRD	0.19	0.18	0.17	0.16	0.15
C FRASER VAL	0.01	0.01	0.01	0.01	0.01
DEWDNEY AL.	0.03	0.03	0.03	0.04	0.04
FRASER CHEAM	0.01	0.01	0.01	0.02	0.02
REST OF B.C.	0.76	0.77	0.77	0.78	0.78
METAL FABR.					
GVRD	0.49	0.47	0.45	0.43	0.41
C FRASER VAL	0.03	0.04	0.05	0.06	0.07
DEWDNEY AL.	0.00	0.01	0.01	0.01	0.01
FRASER CHEAM	0.01	0.01	0.01	0.01	0.01
REST OF B.C.	0.47	0.48	0.48	0.49	0.49
CHEMICAL					
GVRD	0.77	0.81	0.85	0.79	0.72
C FRASER VAL	0.02	0.03	0.04	0.05	0.06
DEWDNEY AL.	0.00	0.00	0.00	0.00	0.00
FRASER CHEAM	0.00	0.00	0.00	0.00	0.00
REST OF B.C.	0.20	0.15	0.11	0.16	0.21
NON MET MIN.					
GVRD	0.58	0.61	0.65	0.69	0.72
C FRASER VAL	0.02	0.03	0.04	0.05	0.05
DEWDNEY AL.	0.01	0.01	0.01	0.01	0.01
FRASER CHEAM	0.02	0.02	0.02	0.02	0.02
REST OF B.C.	0.38	0.34	0.28	0.24	0.20
FOOD & BEV.					
GVRD	0.66	0.67	0.67	0.68	0.69
C FRASER VAL	0.07	0.08	0.09	0.10	0.10
DEWDNEY AL.	0.01	0.01	0.02	0.02	0.02
FRASER CHEAM	0.05	0.05	0.05	0.05	0.06
REST OF B.C.	0.22	0.19	0.17	0.15	0.13
MISC MANUF					
GVRD	0.89	0.87	0.84	0.82	0.79
C FRASER VAL	0.03	0.03	0.04	0.04	0.05
DEWDNEY AL.	0.02	0.02	0.03	0.04	0.04
FRASER CHEAM	0.01	0.01	0.01	0.01	0.01
REST OF B.C.	0.05	0.06	0.08	0.09	0.11
WHOLSL TRADE					
GVRD	0.56	0.55	0.53	0.52	0.50
C FRASER VAL	0.03	0.03	0.03	0.04	0.04
DEWDNEY AL.	0.02	0.02	0.02	0.02	0.02
FRASER CHEAM	0.02	0.02	0.02	0.02	0.02
REST OF B.C.	0.38	0.39	0.40	0.41	0.42

discussion of assumptions noted previously) and GVRD land prices begin to heat up again, the region declines in attractiveness over the final five to ten years of the forecast horizon from the peaks reached in the early 1990's.

- For those industries particularly sensitive to land prices (e.g. forest products and metal fabrication) Central Fraser scores exhibit similar behaviour to GVRD scores. However, since the acceleration in prices in Central Fraser is even more dramatic than in GVRD, the resulting decline in attractiveness in the late 1990's is even more dramatic than in GVRD for price sensitive industries.

- Offsetting this consequence in some industries, Central Fraser is improving its score in other factor conditions and hence the regional attractiveness scores decline only marginally for industries rating relative land costs less important (e.g. chemicals and miscellaneous manufacturing).

- In the case of Dewdney Alouette and Fraser Cheam, the improvement in factors such as distance from markets served, availability of labour supply, and transportation infrastructure more than offset deteriorating land prices, even in the late years of the forecast. Therefore, regional attractiveness scores for these regions are steadily increasing in all industry sectors for all years.

These regional attractiveness scores serve as input to the regional output share forecasting module. This module combines information on historical trends in changing share by region with forecast values of region attractiveness scores by industry. The forecast results are presented in Table 17 on the facing page.

In the forest products industry, the GVRD is expected to lose share to all of the other regions. In the case of the large,

primary manufacturing forest products sector, this loss of share is expected to be transferred to locations outside the Lower Mainland altogether: all industry respondents indicated that land sites within the Lower Mainland are too expensive and/or non-existent for major facilities, and all new major capital expansion would therefore be outside the Lower Mainland. In the case of secondary and tertiary wood products manufacturing, GVRD will be losing share to the other Lower Mainland regions as a function of land costs in the GVRD and improved infrastructure in the outlying regions.

In metal fabrication, Central Fraser will continue its trend of gaining share at the expense of GVRD. Also, but to a lesser extent, the rest of B.C. will be gaining share. Based on generally improving scores for the outlying Lower Mainland regions, Dewdney Alouette and Fraser Cheam will increase market share, but very slowly.

In the chemical industry, the only two regions of major significance are GVRD and the rest of B.C. For the first decade of the forecast, GVRD is expected to continue to increase share as it has done in the past decade. However, using 1991 as a turning point for northern B.C. petrochemical development, GVRD very quickly begins to lose share in the second half of the forecast, with almost all of the share loss going to areas outside the Lower Mainland. By the end of the forecast, GVRD share has dropped back to levels close to 1981 levels.

In the case of non-metallic minerals, GVRD is expected to continue to increase share, but at a slower rate than observed in the later 1970's. The slowdown in the rate of increase comes as a result of a reversal in the momentum position for Central Fraser. Historical data show that Central Fraser lost share in this industry in the late 70's, but industry response from the

Table 18

OUTPUT BY REGION
MILLIONS OF $81

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	1322	1313	1378	1535	1521
METAL FABR.	1080	1093	1193	1612	1851
CHEMICAL	1814	1991	2295	2638	2766
NON MET MIN.	252	283	343	464	562
FOOD & BEV.	1783	1786	2018	2534	2989
MISC MANUF	1594	1723	1921	2495	3054
WHOLSL TRADE	10327	11092	12837	16061	19919
TOTAL	18180	19281	21970	27339	32581
C FRASER VAL					
FOREST PROD.	46	66	90	126	151
METAL FABR.	69	99	141	239	332
CHEMICAL	54	81	115	170	221
NON MET MIN.	9	14	21	32	42
FOOD & BEV.	188	212	265	359	435
MISC MANUF	47	63	88	136	194
WHOLSL TRADE	513	649	848	1165	1788
TOTAL	918	1185	1568	2227	2963
DEWDNEY AL.					
FOREST PROD.	186	219	278	357	413
METAL FABR.	9	14	21	30	57
CHEMICAL	4	5	5	7	8
NON MET MIN.	3	3	4	5	5
FOOD & BEV.	31	38	48	66	82
MISC MANUF	34	50	78	113	167
WHOLSL TRADE	285	325	410	561	762
TOTAL	552	654	829	1146	1494
FRASER CHEAM					
FOREST PROD.	87	95	115	148	169
METAL FABR.	14	19	27	46	66
CHEMICAL	4	2	3	3	4
NON MET MIN.	7	7	8	11	12
FOOD & BEV.	120	132	156	203	242
MISC MANUF	25	24	23	26	28
WHOLSL TRADE	285	325	410	561	763
TOTAL	537	604	742	1000	1284
REST OF B.C.					
FOREST PROD.	5327	5628	6311	7447	8289
METAL FABR.	1059	1128	1291	1846	2251
CHEMICAL	468	378	298	537	821
NON MET MIN.	147	159	158	158	154
FOOD & BEV.	568	518	586	549	551
MISC MANUF	90	126	176	280	413
WHOLSL TRADE	6990	7985	9630	12718	16663
TOTAL	14661	15835	18355	23726	29862
REGION TOTAL					
G V R D	18180	19281	21970	27339	32581
C FRASER VAL	918	1185	1568	2227	2963
DEWDNEY AL.	552	654	829	1146	1494
FRASER CHEAM	537	604	742	1000	1284
TOTAL L.M.	20187	21723	25108	31712	38324
REST OF B.C.	14661	15835	18355	23726	29862
TOTAL B.C.	34768	37558	43463	55438	67386

interviews indicates that Central Fraser should in fact see some above average expansion in the coming years.

In the food and beverage industry, the most significant aspect of the forecast is a continuing decline in share for the Rest of B.C. The area outside the Lower Mainland lost nine share points in the late 70's, and while this rate of loss is expected to slow down, by 2001 the rest of B.C. is expected to account for approximately 13% of total industry output as compared to 22% in 1981. Each of the other Lower Mainland regions picks up some of this share loss, with the major gains going to Central Fraser and GVRD in line with their attractiveness scores far ahead of the other regions.

In miscellaneous manufacturing, there is an expectation of continued adjustments in share to reflect the fact that the dispersion of region attractiveness scores is not broad enough to justify GVRD's absolute dominance in this industry. Each of the other four regions are expected to gain share at the expense of GVRD. In particular, the rest of B.C. will gain share quite quickly. Aided by some major resource-based projects on the forecast horizon, miscellaneous manufacturing and metal fabrication are expected to be the two strong manufacturing sectors for the rest of B.C.

For these same reasons, the rest of B.C. is expected to increase share of wholesale trade activity. This comes exclusively at the expense of GVRD, which is expected to lose six share points. Each of the other Lower Mainland regions shows virtually no change at all in market share of total wholesale trade activity.

By applying these regional shares to forecasts for total B.C. output, forecast values for output by industry sector can be developed for each region. Table 18 on the facing page provides information grouped by region.

Overall, GVRD maintains share of total manufacturing activity during the first decade of the forecast at 47%. In the second decade of the forecast, GVRD loses almost two percentage points in share of total B.C. manufacturing output. This comes about in response to two major contributing forces. First, 1991 is used as the turning point for the chemical industry, after which time GVRD is expected to dramatically lose share to the rest of B.C. Second, the two industries showing the most vigorous growth in the latter part of the forecast, metal fabrication and miscellaneous manufacturing, are both sectors in which GVRD is steadily losing share.

Each of the other three Lower Mainland regions is staying even or gaining in share in every one of the manufacturing sectors, albeit at varying rates of increase. Consequently, each of the regions is steadily increasing its share of total B.C. manufacturing output. Central Fraser is increasing most rapidly, gaining three share points over the forecast, and Fraser Cheam grows most slowly, increasing market share by one-half of 1%.

In the case of the rest of B.C., the region continues to lose share of total manufacturing activity as has been the case in the 1970's. The drop in shares is most dramatic in the first half of the forecast, and slowed down somewhat by strong growth in chemicals, metal fabrication, and miscellaneous manufacturing in the second half of the forecast. However, even the strong growth in these three sectors in the latter half of the forecast is not enough to totally reverse the trend in overall share decline for the region (a loss of 1/2% betwen 1991 and 2001).

While the previous discussion has focussed on output levels in terms of percentage shares, it is important to keep in mind that even industries and regions which are losing share of total B.C. output are continuing to grow in absolute terms. In other words, even for industry sectors which are losing share, the overall rate of industry

Table 19

RESIDUAL INDUSTRIES LAND PROJECTIONS
5 YEAR GROWTH RATES

MAJOR TRANS.	81 BASE	'81-'86	'86-'91	'91-'96	'96-'01
GVRD	9214	0.01	0.01	0.01	0.01
C FRASER VAL	1541	0.01	0.01	0.01	0.01
DEWDNEY AL.	0	0.01	0.01	0.01	0.01
FRASER CHEAM	484	0.01	0.01	0.01	0.01
OTHER TRANS					
GVRD	1876	0.05	0.05	0.05	0.05
C FRASER VAL	314	0.05	0.05	0.05	0.05
DEWDNEY AL.	23	0.05	0.05	0.05	0.05
FRASER CHEAM	381	0.05	0.05	0.05	0.05
UTILITIES					
GVRD	3184	0.01	0.01	0.01	0.01
C FRASER VAL	28	0.20	0.20	0.20	0.20
DEWDNEY AL.	2	0.20	0.20	0.20	0.20
FRASER CHEAM	35	0.20	0.20	0.20	0.20

growth in the province is sufficient to more than offset this share loss and therefore result in some level of increase in real output.

The preceding material on density, share change, and overall economic growth forms the basis for developing land forecasts for each of the six manufacturing sectors and the wholesale trade sector. As noted in Section III on study methodology, the procedure used for developing forecasts for the other three industry sectors, major transportation, other transportation and storage, and utilities, was to forecast rates of increase in land directly. The following part of this report describes the assumptions used in these three industry sectors, and the following part then brings together all of the preceding information in order to develop total land demand forecasts by region.

D. RESIDUAL INDUSTRIES LAND FORECASTS

This part is broken down into a discussion of forecast assumptions for each of the three sectors which were modelled directly on a rate of growth in land basis: major transportation, other transportation and storage, and utilities and communication.

Table 19 on the facing page presents the assumptions used for growth rates for each of these three sectors in each of the Lower Mainland regions.

1. Major Transportation

The major transportation sector data are an aggregation of land used in three categories: airports, railways and railway rights-of-way, and piers. In order to develop forecasts for land demand in these categories, the study team interviewed planning representatives of the following firms as to their anticipated requirements to the year 2001:

- National Harbours Board
- B.C. Harbours Board
- Canadian National Railway
- Canadian Pacific Railway
- North Fraser Harbour Commission
- Transport Canada
- Vancouver International Airport
- Fraser River Harbour Commission
- B.C. Hydro (transportation)

In general terms, these agencies anticipate limited additional demand for industrial land. In particular cases, an oversupply is the case presently, and with limited exceptions, room for expansion exists through to the year 2001. More specifically, the following expectations were established based on these interviews:

- Rail

  Demand for land for rail exists for three main purposes: as rights-of-way, marshalling yards for trains and for servicing intermodal (mostly track) yards. In the case of the intermodal facilities, the railroads work with freight forwarding companies, for example, in either developing or designing the yard sites, but generally confine themselves to providing trackage for such facilities.

  No additional demand for rights-of-way are anticipated. However, some additional land for both rail and intermodal yards are anticipated. One interviewee reported that an additional 75 acres of land will be required for expanding existing rail marshalling yards; a new, larger intermodal site will be needed in the order of an additional 50 acres net of the existing site. Both requirements will be within the GVRD and will come prior to 1991. The other two rail firm

interviewees indicated that they anticpated no additional requirements within the study's time frame.

- Airports

Discussions with planners at both Vancouver International Airport and the Ministry of Transport revealed that the regions' four major airports - Vancouver International, Boundary Bay, Pitt Meadows and Abbotsford - all have sufficient land to accommodate anticipated growth through the turn of the next century.

- Ports/Piers

Four agencies with responsibility for port planning in various jurisdictions were consulted. Although all were able to discuss prospects for water and, in some cases, foreshore land demand, none offered precise quantitative information.

More specifically, the Port of Vancouver has recently concluded a master plan for the port. Discussions with a Port official indicated that, based on expected demand by the year 2000, a total of 140-160 acres in Burrard Inlet might be required for port uses. Part of this land will be fill. This compares with a total existing land area of approximately 780 acres in use at the Port of Vancouver (not including land owned and used by specific industries, such as refineries).

In terms of Robert's Bank, approximately 100 additional acres are being developed at present; demand for additional land is not known. The British Columbia Harbours Board owns an additional 4000 backup acres in Delta adjacent to the Port. The Board was unable to speculate as to the extent of demand for this land.

Development of water lots along the Fraser River is planned under two separate jurisdictions: by the North Fraser Harbours Commission; and the Fraser River Harbours Commission. Land along the north arm is largely taken up by the forest products, aggregate, steel and metal, and fish-packing industries. The main arm of the Fraser can accommodate deepsea vessels but is not generally well suited for bulk commodities. These land areas are included within the industrial sector data provided by the GVRD and other regional districts and forecasted under the industrial categories where land demand is expected to occur.

In summary, total land demand directly for actual transportation uses is not expected to exceed an additional 125 acres for rail use before 1991, and a total of 240-260 acres for port use before the end of the study's time horizon.

2. Other Transportation and Storage

This category is heterogeneous with respect to content. It consists, for example, of land dedicated to construction equipment and materials storage, trucking uses, junk and new car storage, and in the case of one regional district, dry land sort of logs. Even at the higher level of disaggregation of 23 industry sectors as used in Project One, it is difficult to derive homogeneous usage categories that are strictly industrial.

Because this sector is not dominated by large major users, no interview program was conducted as with major transportation or communications and utilities firms to ascertain expected future land demand. Historical data from the GVRD suggest that land demand in this sector grew slowly over the last five years. This is likely due to the high cost of land in the GVRD. Also,

it may be that activity in this sector shifted to Central Fraser, where it now consumes a significant proportion of total land use. However, without any data as to historical absorption rates within the regional districts other than the GVRD, or historical output data for this sector, is is extremely difficult to anticipate future requirements. Based on the limited findings of the study team, a growth rate of 5% was used in the base forecast.

3. Communications and Utilities

The vast majority of land in this category has been taken up by B.C. Telephone and B.C. Hydro, both of whom were consulted as to their future land use. Both are making major revisions of their land demand expectations. Much less land is expected to be needed in the future than in the past two decades.

B.C. Hydro reports that it has required approximately an additional 20 acres per year in the Lower Mainland over the course of the 1970's. It expects that rate of increase to slow to near zero as the result of slower demand for services, and the development of a major service complex in Surrey.

Although B.C. Telephone is in the process of revising its plans, the company indicated that its average past consumption of approximately 10 acres per year in the Lower Mainland would be reduced significantly. This is expected to result from the greater efficiency of electronic circuitry which reduces the land requirements for switching facilities, and consolidation of equipment marshalling yards. Morevover, demand which does exist is expected to take place outside the GVRD.

In summary, on the basis of the information regarding expected future land requirements which was obtained, it is reasonable to expect that a maximum of 10 acres per year will be required to

Table 20

TOTAL LAND REQUIREMENTS
IN ACRES

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	1943	1938	2007	2195	2138
METAL FABR.	1218	1161	1282	1512	1628
CHEMICAL	1912	2022	2235	2436	2628
NON MET MIN.	522	522	556	648	674
FOOD & BEV.	649	641	676	777	838
MISC MANUF	972	1042	1143	1438	1687
TOT MANUF	7288	7326	7818	9006	9369
WHOLSL TRADE	2582	2586	2852	3389	3806
MAJOR TRANS	9214	9386	9399	9493	9588
OTHER TRANS	1876	1978	2068	2172	2288
UTILITIES	3184	3135	3166	3198	3230
TOTAL	23984	24323	25384	27178	28273
C FRASER VAL					
FOREST PROD.	161	228	301	402	459
METAL FABR.	73	99	132	203	257
CHEMICAL	84	78	104	144	174
NON MET MIN.	86	128	161	207	229
FOOD & BEV.	138	153	175	213	237
MISC MANUF	61	78	104	153	205
TOT MANUF	573	765	978	1323	1560
WHOLSL TRADE	254	309	373	478	583
MAJOR TRANS	1541	1556	1572	1588	1604
OTHER TRANS	314	330	346	363	382
UTILITIES	28	34	48	48	58
TOTAL	2710	2994	3389	3793	4187
DEWDNEY AL.					
FOREST PROD.	266	315	376	472	522
METAL FABR.	9	13	19	31	42
CHEMICAL	4	5	5	6	6
NON MET MIN.	26	24	23	25	24
FOOD & BEV.	14	16	19	23	26
MISC MANUF	25	36	50	76	105
TOT MANUF	344	489	491	632	725
WHOLSL TRADE	14	15	18	22	28
MAJOR TRANS	8	8	8	8	8
OTHER TRANS	23	24	25	27	28
UTILITIES	2	2	3	3	4
TOTAL	383	451	530	685	785
FRASER CHEAM					
FOREST PROD.	137	159	186	229	250
METAL FABR.	14	18	24	37	49
CHEMICAL	132	132	132	132	132
NON MET MIN.	67	64	64	68	67
FOOD & BEV.	53	55	59	69	76
MISC MANUF	21	28	19	28	28
TOT MANUF	424	456	484	554	593
WHOLSL TRADE	36	39	46	58	71
MAJOR TRANS	484	489	494	499	504
OTHER TRANS	381	488	428	441	463
UTILITIES	35	42	58	68	73
TOTAL	1360	1428	1494	1614	1704
G V R D	23984	24323	25384	27178	28273
C FRASER VAL	2710	2994	3389	3793	4187
DEWDNEY AL.	383	451	530	685	785
FRASER CHEAM	1360	1428	1494	1614	1704
TOTAL L.M.	28357	29189	30645	33271	34950

service communications and utilities users, much of which will fall outside the GVRD.

With all of the preceding analysis in place, the next part of this report presents the base forecast for industrial land demand through 2001.

E. INDUSTRIAL LAND DEMAND FORECAST

This part of the report presents the base forecast for industrial land demand in the Lower Mainland through the year 2001. The forecast numbers present land requirements on a stock basis. A simple differencing of forecasts between time periods provides information on net changes in industrial land for the industry and/or region. It is important to note that this simple differencing will not take account of gross industrial land requirements as discussed in the study conducted by David Baxter (described in Section II), which speculates that as much as 1.5 gross acres are required for every net incremental acre to account for disappearance of existing industrial land to alternative uses. However, translating the net land requirements to gross land requirements is a simple exercise, requiring the user to simply increase the net requirements by an assumption of the amount of industrial land expected to be rezoned and converted to other uses during the forecast interval.

Table 20 on the facing page presents the forecast in detail by region and industry sector. Given the preceding analysis of density, regional shares, the economic environment, and expected future demand for the residual industries, the table generally speaks for itself. This part of the report therefore draws attention only to the major highlights of the forecast.

In the GVRD, demand for industrial land is expected to grow from a base of approximately 24,000 acres in 1981 to just over 28,000 acres by the turn of the century. This represents an average increase of

just over 200 acres per year. However, the growth in industrial land is heavily weighted to the second decade of the forecast. Focussing on the manufacturing sectors, the increase in demand for land in the 1980's averages less than 100 acres per year. Once economic activity picks up dramatically in the 1990's, the average demand increases to approximately 150 acres per year. Given that the manufacturing sector only accounted for 30% of total industrial land requirements in the GVRD in 1981, this strong growth in the 1990's means that by the end of the forecast period, the manufacturing sector increases its share of the total industrial land in the GVRD from 30% to 33%. The other major source of demand for industrial land in the GVRD is the wholesale trade sector, which continues to grow fairly quickly throughout the entire forecast.

Demand for land in Central Fraser follows a somewhat similar profile as the GVRD that the strongest period for increased land requirements is the 1990's. However, the fluctuations in average annual land requirements are less dramatic than for the GVRD. This is because the Central Fraser is consistently gaining share in all industry sectors, and therefore the swings in economic activity are not further amplified by share loses in some sectors before being translated into land demand. Given the slow increase in demand for major transportation, other transportation, and utilities, the bulk of the demand for incremental land in the region comes from growth in the manufacturing sector. The manufacturing sector jumps from 21% of land requirements in the region in 1981 to 37% by 2001. In terms of total acres, the region grows by approximately one-third as much as the GVRD, but on a percentage basis, this represents 50% growth for Central Fraser over the 1981 base.

Dewdney Alouette shows, on a percentage basis, the most dramatic increase in industrial land. The region's demand for land more than doubles by the turn of the century. However, given the small base from which the region starts, in the context of total land demand, this still represents only 400 total acres required over the forecast

horizon. Given that the 1981 figures reported by the region exclude numbers for major transportation, the historical percentage for manufacturing is perhaps artificially high in the context of this study, starting at 90% of the total land requirements for the region. At the same time, the same trend as exhibited in the other regions is expected to hold for Dewdney Alouette, implying an increase in the share of total land required in the region being taken up by the manufacturing sector. On a percentage basis, the two industry sectors showing the strongest demand growth for land in the region are metal fabrication and miscellaneous manufacturing.

Fraser Cheam shows the lowest total increase in land requirements over the forecast horizon, with a net increase of approximately 350 acres. On a total percentage growth basis, Fraser Cheam performs better than GVRD, but not nearly so well as the other two Lower Mainland regions. Within the manufacturing sector, the most vigorous growth comes from the forest products and metal fabrication sectors, the former increasing its share of total land requirements by a full five percentage points over the forecast horizon, and the latter increasing its share by two percentage points.

A supplementary set of forecast tables is provided in Appendix I to this report, containing rates of growth in land demand, percentage shares, etc.

F. ALTERNATIVE FORECAST SCENARIOS

As discussed in the methodology section of the report, one of the major benefits of developing a computerized forecasting model is that alternative scenarios can be quickly generated to test the sensitivity of forecast assumptions on the total demand for industrial land in the Lower Mainland. Study sponsors have been supplied with a full set of forecasting programs, and it is expected that they will develop their own forecasts which reflect their own assumptions on future economic conditions, etc. At the same time, it

is useful to present a limited number of alternative forecasts within the context of this study so as to provide insight into the major areas of sensitivity in the demand for industrial land.

Three alternative scenarios have been developed and presented here for scrutiny:

- a high economic growth scenario,
- a low economic growth scenario, and
- a base level economic growth scenario coupled with no change in regional factor conditions from the 1981 base.

This part of the report provides a very brief overview of the forecast results for each of these scenarios. Appendix II of the report presents the land requirements forecast table for each of the three scenarios.

1. High Economic Growth Scenario

In this scenario, the only change in assumptions from the base forecast relate to rates of economic growth in the first decade. As noted previously, the base forecast shows vigorous economic growth in the 1990's, but very sluggish performance in the first decade. This forecast increases the annual growth rate in each industry by one-half percentage point in the 1981-86 period, and by one full percentage point in the 1986 to 1991 period. The high growth rates forecast for the 1990's are left unchanged.

As compared to the base forecast, this increased economic growth results in a total additional demand for industrial land in the Lower Mainland of 1,300 acres by the turn of the century. In total, land demand increases by 8,000 acres over the 20 years, implying an average increase of 400 acres per year for the Lower

Mainland. Five thousand acres of the total increase are shown to be in the GVRD, implying average increases of approximately 250 acres per year.

2. Low Economic Growth Scenario

This forecast takes the basic economic growth assumptions for 1981 through 1991 and leaves them unchanged. However, the high growth rates forecast for the 1990's have been reduced so that the rates of growth forecast for 1986 through 1991 are also used for the second decade for the forecast.

The resulting change to the forecast in this scenario is more dramatic on the down side than the high growth scenario is on the up side for land requirements. Whereas the high growth scenario increased land requirements by slightly more than 1,000 acres, the low growth scenario decreases requirements by 2,300 acres over the forecast horizon. In this scenario, total land requirements over the 20 years increased by approximately 4,000 acres, implying average annual growth rates of about 200 acres per year for the entire Lower Mainland. Each of the regions within the Lower Mainland show reduced demand, but the major impact is felt by the GVRD, which now shows a total increase over the forecast horizon of 2,400 acres, or an average of 120 acres per year. This compares with the base forecast average increase for the GVRD of just over 200 acres per year, and the high growth scenario of 250 acres per year for the GVRD.

3. Base Level Economic Growth - No Change in Region Factor Conditions

This forecast is presented to demonstrate the sensitivity of the demand for industrial land to changing factor conditions within the regions. While it is very unlikely that the region scores for each of the factor conditions affecting density and region

share will remain unchanged throughout the entire forecast horizon, the scenario is presented as a "benchmark" forecast against which more plausible region condition forecasts can be compared. Specifically, this forecast is generated by leaving the factor condition scores at the 1981 index level of 1.0 throughout the entire forecast.

In this forecast, each region and each industry demonstrate the "momentum" changes in output share and density developed during the research phase of the study. The overriding impact on land demand which results from this forecast is accounted for by a dramatic increase in density, such that total land requirements across virtually every region and industry are significantly reduced from the base level. In fact, this forecast produces land demand forecasts which are significantly lower than the low economic growth scenario previously discussed. Total land requirements for the Lower Mainland increas by 2,500 acres over the entire 20-year horizon. This represents an average annual increase of 125 acres per year for the entire Lower Mainland. Again, the region showing the greatest sensitivity on an absolute basis and on a percentage basis is the GVRD. Total land requirements over the 20 years increase by only 800 acres, implying an average annual increase of only 40 acres per year for the GVRD in this scenario.

Again, it is important to emphasize that this forecast is not presented as a likely potential outcome for land demand in the Lower Mainland, but rather serves as a benchmark against which forecasts for changing factor conditions within regions can be compared.

As discussed more fully in Section III and Section IV of the Technical Report, model users can generate a virtually infinite set of alternative forecasts using the computer model which has been developed. Reference to these two sections of the Technical Report provide adequate detail for model users to generate alternative forecasts.

VI. CONCLUSIONS

This section of the report is divided into three parts. Part A presents some of the major overall findings of the study. Part B presents the study team's recommendations for ways in which the study results and analysis can be improved in the future and Part C provides some additional general summary comments.

A. OVERVIEW OF STUDY FINDINGS

Based on over 50 interviews with a representative set of companies operating in the Lower Mainland, a general framework for capturing the framework in which businessmen make land decisions was developed. On the one hand, decisions to purchase land for industrial use were partially influenced by a generally held perception that land is a solid investment. For that reason, certainly in the era of relatively cheap land prices, businessmen were relatively unconcerned with maximizing the return on land investment in the context of industrial production. In more recent years, as a function of rapidly increasing land costs and relative scarcity of choice sites in the Lower Mainland (and particularly in the GVRD), businessmen are now approaching decisions with regard to industrial land consumption much in the same way was they approach decisions regarding consumption of any other factor of input to the production process. In this respect, industrial land consumption has followed a history which is fairly similar to changing industrial habits regarding energy consumption: businessmen are now much more careful to plan their land use, "conserve" land by increasing output per unit as much as possible, and substitute away from land in favour of a more efficient production process and holding less land inventory.

This evolution of the land planning process is reflected in a decision structure which is essentially bottom-up. Businessmen develop their current and future land needs based on thorough facilities planning and future growth planning.

As well as having a greater sensitivity to minimizing the cost of land as a factor of input, businessmen have become more sensitive to regional disparities in land costs and other key determinants of competitive success. Companies are therefore taking a more sophisticated approach to determining the location of future expansions than they did in the past.

Based on the interview findings, it is clear that the decisions with regard to amount of land needed and regional location are approached in a similar fashion across all industry sectors. However, the extent to which the various factors influence these decisions varies in magnitude across industry sectors. Not surprisingly, for example, land costs are more important to those industries for which land represents a significant percentage of total factor costs, whereas land availability for future growth is more important to those industries which would incur the greatest relocation costs should they run out of land at their current sites.

In terms of the forecast itself, land demand in the Lower Mainland is expected to increase by approximately 300 acres per year on average. The increase in demand is more heavily concentrated in the second decade of the forecast owing to more vigorous economic growth projections.

The forecast is sensitive to assumptions on changing factor conditions in various regions. Regional attractiveness scores are important in explaining output share and therefore total land demand within any region. However, factors affecting density change seem to exert a greater marginal impact on the forecastthan do region attractiveness socres. Furthermore, it is more likely that the forecast overstates the future demand for industrial land than understates it since the forecasted density changes are more likely to be understated than overstated. This bias is due to the combination of the fact that the forecast assumes fairly significant relief in interest rates and land costs, and the fact that the

momentum density changes used in the model are significantly lower in some cases than those which have been historically observed. (This is a result of encorporation of findings from the industry interview program).

Finally, since the findings from this study have been synthesized in a readily accessible computerized forecasting model, study sponsors will be able to quickly generate alternative scenarios. These scenarios can be developed to reflect perceptions of future changes in regional conditions or economic growth, or in terms of proposed policy changes in taxation, zoning requirements, or government incentives.

B. POTENTIAL STUDY IMPROVEMENTS

As has been discussed more fully in Section II of the Technical Report on data, the study team was somewhat restricted in the depth of analysis which could be performed due to a scarcity of comprehensive historical data. In particular, it is expected that the accuracy of the study findings could be improved in time as better data become available in three different categories. In addition to the three data issues, a fourth area for improvement relating to choice of computers is also discussed in the following material.

1. Industrial Land Data

In terms of the historical data on demand for industrial land, two major shortcmings became evident to the study team. First, the data do not break out land held in inventory by industry as opposed to land currently in productive use. For this reason, it was impossible to explicitly model changes in the inventory stock as being separate from other changes in land density. Ideally, if data could be developed on inventoried land, this issue could be addressed directly. The study team gathered some

preliminary data on inventoried land through the industry interview program, however the sample size was not viewed as being large enough to explicitly extrapolate these numbers to estimate total land inventory holdings by industry by region. Instead, the interview results on inventory were used as a very significant input to the development of trend values for density change and subsequent development of the density forecasts.

The second shortcoming with regard to historical data on land relates to the absence of significant history prior to 1981. As noted, GVRD is the only regional district for which data are available prior to 1981, and in this case the study team was limited to only one additional year of data (1976). It is the study team's understanding that additional historical data cannot be generated in a cost-effective manner. However, if each of the regional districts is able to continually update their current data base, a historical data base on density and total land demand by industry sector will gradually evolve simply through the passage of time. Consequently, in some future year, this study can be updated to reflect what will then be historical trends emerging in each of the regional districts.

2. Industrial Output Data

While the study team paid careful attention to the issue of aggregation of Project One data such that they would conform to the level of data available on industry output, it is understood that the study findings would be enhanced if a greater level of disaggregation could have been used. However, as noted in the Technical Report, the major constraining factor on the level of disaggregation relates to the level of industry output detail available on a historical and forecast basis. Additionally, even for those industry sectors which were modelled, in many cases regional output values are not available from government data

sources for some of the smaller Lower Mainland regional districts.

As with the problem of lack of significant historical data on land consumption, this problem cannot be alleviated through a greater effort to produce historical data for years prior to 1981. More likely, the study results can be improved in some future year if and when more detailed economic data have then been gathered and reported by either the federal or provincial government statistical agencies.

3. Corporate Data

In order to satisfy the budget constraints imposed upon this study, provisions were made to conduct 56 industry interviews. While the study team felt that this number of interviews was certainly sufficient to develop a comprehensive analytical framework and forecasting model, the study results would obviously have a narrower confidence interval if the number of respondents was increased. In particular, this issue is most relevant to those industry sectors and regions where the number of interviews conducted was comparatively low.

Future enhancements to the study could be generated by conducting a larger number of interviews. In addition, it should be kept in mind that as with any forecasting model, in order for the system to maintain its integrity, the model coefficients need to be updated on a periodic basis. Consequently, even if the total number of industry interviews conducted at some future date is not increased, it is imperative that if the forecasting model is to maintain credibility, a follow-up set of interviews should be conducted every few years.

4. Choise of Host Computer

An unforseen drawback of the existing study relates to the choice of a micro-computer as the host hardware for the forecasting model. As noted previously in this report, a micro-computer was chosen due to its low cost and portability, in order to increase the likelihood that a number of study sponsors would have access to the necessary hardware to therefore take the forecasting system "in-house". In hindsight, it is still considered to have been the appropriate course of action to follow, but perhaps with some reservation. In particular, the fact that the model had to be developed in discrete submodules rather than as a single large forecasting system presents some level of ongoing irritation to the model-user. In particular, interim results have to be shunted from one sub-module to another given the capacity constraints of micro-computers. As the capacity of micro-computers increases over time, also resulting in comensurate increases in computational speed, it will likely be worthwhile for a marginal investment to be made in recompiling the model onto a larger system, with the net effect being an elimination of the sub-module configuration.

C. GENERAL SUMMARY COMMENTS

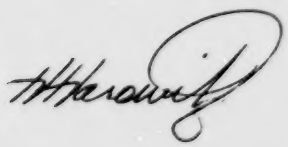
This study has been a success in that it has significantly advanced the technology available to analyse and forecast the demand for industrial land. New and detailed data have been developed pertaining to the underlying factors which drive industrial land demand. Also, the analytical framework developed during the study has been explicitly modelled, and computerized in an interactive user-friendly system to provide planners with an ability to analyse alternative scenarios resulting from changes in economic assumptions, or potential changes in government policy.

The resulting forecasts provide detailed estimates of industrial land requirements, by industry sector, for each of the four Regional Districts to 2001. In addition, the implications on the rest of the province of the forecasts for the Lower Mainland are developed in terms of economic activity by sector in the rest of B.C.

A number of specific areas have been identified for potential improvement in the analysis at some future date. These areas are concerned mainly with improving the historical data base.

The results of this study provide planners and policy makers not only with up-to-date and detailed demand forecasts, but also a forecasting and analysis tool that can be used on an ongoing basis. The analytical system, along with the Regional Districts' supply estimates, will allow the overall industrial land study to proceed towards the development of a comprehensive industrial development strategy for the Lower Mainland.

CURRIE, COOPERS & LYBRAND



Howard G. Harowitz

HH/nh

APPENDIX I

BASE CASE SCENARIO

SUPPLEMENTARY FORECAST TABLES

TOTAL LAND REQUIREMENTS
AVERAGE ANNUAL CHANGE IN ACRES

G V R D	'81 BASE	'81-'86	'86-'91	'91-96	'96-'01
FOREST PROD.	1943	-1	14	38	-13
METAL FABR.	1210	-10	8	62	22
CHEMICAL	1912	22	43	40	-3
NON MET MIN.	522	8	7	19	5
FOOD & BEV.	649	-2	7	28	12
MISC MANUF	972	14	20	59	58
TOT MANUF	7208	24	98	238	73
WHOLSL TRADE	2502	17	53	91	99
MAJOR TRANS	9214	18	19	19	19
OTHER TRANS	1876	19	28	21	22
UTILITIES	3104	6	6	6	6
TOTAL	23984	84	196	375	219
C FRASER VAL					
FOREST PROD.	161	13	15	20	11
METAL FABR.	73	5	7	14	11
CHEMICAL	54	5	5	8	6
NON MET MIN.	86	8	7	9	4
FOOD & BEV.	138	3	4	8	5
MISC MANUF	61	3	5	10	10
TOT MANUF	573	38	43	69	47
WHOLSL TRADE	254	11	13	19	23
MAJOR TRANS	1541	3	3	3	3
OTHER TRANS	314	3	3	3	4
UTILITIES	28	1	1	2	2
TOTAL	2710	57	63	97	79
DEWDNEY AL.					
FOREST PROD.	266	10	12	19	10
METAL FABR.	9	1	1	2	2
CHEMICAL	4	0	0	0	0
NON MET MIN.	26	0	0	0	0
FOOD & BEV.	14	0	1	1	1
MISC MANUF	25	2	3	5	6
TOT MANUF	344	13	16	28	19
WHOLSL TRADE	14	0	1	1	1
MAJOR TRANS	0	0	0	0	0
OTHER TRANS	23	0	0	0	0
UTILITIES	2	0	0	0	0
TOTAL	383	14	17	29	20
FRASER CHEAM					
FOREST PROD.	137	4	5	9	4
METAL FABR.	14	1	1	3	2
CHEMICAL	132	0	0	0	0
NON MET MIN.	67	0	0	1	0
FOOD & BEV.	53	0	1	2	1
MISC MANUF	21	0	0	0	0
TOT MANUF	424	5	7	15	7
WHOLSL TRADE	36	1	1	2	3
MAJOR TRANS	484	1	1	1	1
OTHER TRANS	381	4	4	4	4
UTILITIES	35	1	2	2	2
TOTAL	1360	12	15	24	18
G V R D	23984	84	196	375	219
C FRASER VAL	2710	57	63	97	79
DEWDNEY AL.	383	14	17	29	20
FRASER CHEAM	1360	12	15	24	18
TOTAL L.M.	28357	166	291	525	336

TOTAL LAND REQUIREMENTS
CUMULATIVE CHANGE IN ACRES

G V R D	'81 BASE	'81-'86	'86-'91	'91-96	'96-'81
FOREST PROD.	1943	-5	64	252	187
METAL FABR.	1210	-49	-8	302	410
CHEMICAL	1912	110	323	524	508
NON MET MIN.	522	0	34	126	152
FOOD & BEV.	649	-8	27	128	189
MISC MANUF	972	70	171	466	715
TOT MANUF	7208	118	610	1798	2161
WHOLSL TRADE	2502	84	350	807	1304
MAJOR TRANS	9214	92	185	279	374
OTHER TRANS	1876	94	192	296	404
UTILITIES	3104	31	62	94	126
TOTAL	23904	419	1400	3275	4369
C FRASER VAL					
FOREST PROD.	161	67	140	241	298
METAL FABR.	73	26	59	130	184
CHEMICAL	54	24	50	90	120
NON MET MIN.	86	42	75	121	143
FOOD & BEV.	138	15	37	75	99
MISC MANUF	61	17	43	92	144
TOT MANUF	573	192	405	750	987
WHOLSL TRADE	254	55	119	216	329
MAJOR TRANS	1541	15	31	47	63
OTHER TRANS	314	16	32	49	68
UTILITIES	28	6	12	20	30
TOTAL	2710	284	599	1083	1477
DEWDNEY AL.					
FOREST PROD.	266	49	110	206	256
METAL FABR.	9	4	10	22	33
CHEMICAL	4	1	1	2	2
NON MET MIN.	26	-2	-3	-1	-2
FOOD & BEV.	14	2	5	9	12
MISC MANUF	25	11	25	51	80
TOT MANUF	344	65	147	288	381
WHOLSL TRADE	14	1	4	8	14
MAJOR TRANS	0	0	0	0	0
OTHER TRANS	23	1	2	4	5
UTILITIES	2	0	1	1	2
TOTAL	383	68	155	302	402
FRASER CHEAM					
FOREST PROD.	137	22	49	92	113
METAL FABR.	14	4	10	23	35
CHEMICAL	132	0	0	0	0
NON MET MIN.	67	-1	-3	1	0
FOOD & BEV.	53	2	6	16	23
MISC MANUF	21	-1	-2	-1	-1
TOT MANUF	424	26	60	132	169
WHOLSL TRADE	36	3	10	22	35
MAJOR TRANS	484	5	10	15	20
OTHER TRANS	381	19	39	60	82
UTILITIES	35	7	15	25	38
TOTAL	1360	60	134	254	344
G V R D	23904	419	1400	3275	4369
C FRASER VAL	2710	284	599	1083	1477
DEWDNEY AL.	383	68	155	302	402
FRASER CHEAM	1360	60	134	254	344
TOTAL L.M.	28357	832	2288	4914	6592

TOTAL LAND REQUIREMENTS
SHARE OF TOTALS

C V R D	1981	1986	1991	1996	2001
FOREST PROD.	0.08	0.08	0.08	0.08	0.08
METAL FABR.	0.05	0.05	0.05	0.06	0.06
CHEMICAL	0.08	0.08	0.09	0.09	0.09
NON MET MIN.	0.02	0.02	0.02	0.02	0.02
FOOD & BEV.	0.03	0.03	0.03	0.03	0.03
MISC MANUF	0.04	0.04	0.05	0.05	0.06
TOT MANUF	0.30	0.30	0.31	0.33	0.33
WHOLSL TRADE	0.10	0.11	0.11	0.12	0.13
MAJOR TRANS	0.39	0.38	0.37	0.35	0.34
OTHER TRANS	0.08	0.08	0.08	0.08	0.08
UTILITIES	0.13	0.13	0.13	0.12	0.11
TOTAL	1.00	1.00	1.00	1.00	1.00
C FRASER VAL					
FOREST PROD.	0.06	0.08	0.09	0.11	0.11
METAL FABR.	0.03	0.03	0.04	0.05	0.06
CHEMICAL	0.02	0.03	0.03	0.04	0.04
NON MET MIN.	0.03	0.04	0.05	0.05	0.05
FOOD & BEV.	0.05	0.05	0.05	0.06	0.06
MISC MANUF	0.02	0.03	0.03	0.04	0.05
TOT MANUF	0.21	0.26	0.30	0.35	0.37
WHOLSL TRADE	0.09	0.10	0.11	0.12	0.14
MAJOR TRANS	0.57	0.52	0.48	0.42	0.38
OTHER TRANS	0.12	0.11	0.10	0.10	0.09
UTILITIES	0.01	0.01	0.01	0.01	0.01
TOTAL	1.00	1.00	1.00	1.00	1.00
DEWDNEY AL.					
FOREST PROD.	0.69	0.70	0.70	0.69	0.66
METAL FABR.	0.02	0.03	0.04	0.05	0.05
CHEMICAL	0.01	0.01	0.01	0.01	0.01
NON MET MIN.	0.07	0.05	0.04	0.04	0.03
FOOD & BEV.	0.04	0.04	0.03	0.03	0.03
MISC MANUF	0.07	0.08	0.09	0.11	0.13
TOT MANUF	0.90	0.91	0.91	0.92	0.92
WHOLSL TRADE	0.04	0.03	0.03	0.03	0.04
MAJOR TRANS	0.00	0.00	0.00	0.00	0.00
OTHER TRANS	0.06	0.05	0.05	0.04	0.04
UTILITIES	0.01	0.01	0.01	0.01	0.01
TOTAL	1.00	1.00	1.00	1.00	1.00
FRASER CHEAM					
FOREST PROD.	0.10	0.11	0.12	0.14	0.15
METAL FABR.	0.01	0.01	0.02	0.02	0.03
CHEMICAL	0.10	0.09	0.09	0.08	0.08
NON MET MIN.	0.05	0.05	0.04	0.04	0.04
FOOD & BEV.	0.04	0.04	0.04	0.04	0.04
MISC MANUF	0.02	0.01	0.01	0.01	0.01
TOT MANUF	0.31	0.32	0.32	0.34	0.35
WHOLSL TRADE	0.03	0.03	0.03	0.04	0.04
MAJOR TRANS	0.36	0.34	0.33	0.31	0.30
OTHER TRANS	0.28	0.28	0.28	0.27	0.27
UTILITIES	0.03	0.03	0.03	0.04	0.04
TOTAL	1.00	1.00	1.00	1.00	1.00
C V R D	0.04	0.03	0.03	0.02	0.01
C FRASER VAL	0.10	0.10	0.11	0.11	0.12
DEWDNEY AL.	0.01	0.02	0.02	0.02	0.02
FRASER CHEAM	0.05	0.05	0.05	0.05	0.05
TOTAL L.M.	1.00	1.00	1.00	1.00	1.00

APPENDIX II

FORECAST TABLES FOR ALTERNATIVE SCENARIOS

FORECASTS OF LAND REQUIREMENTS

HIGHGROWTH SCENARIO

TOTAL LAND REQUIREMENTS
IN ACRES

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	1943	1986	2168	2362	2292
METAL FABR.	1218	1198	1293	1427	1743
CHEMICAL	1912	2073	2485	2422	2685
NON MET MIN.	522	536	599	699	727
FOOD & BEV.	649	657	727	836	982
MISC MANUF	972	1067	1229	1547	1814
TOT MANUF	7288	7518	8414	9693	10883
WHOLSL TRADE	2582	2658	3067	3558	4092
MAJOR TRANS	9214	9386	9399	9493	9588
OTHER TRANS	1876	1978	2068	2172	2288
UTILITIES	3104	3135	3166	3198	3230
TOTAL	23984	24571	26114	28114	29273
C FRASER VAL					
FOREST PROD.	161	233	324	433	494
METAL FABR.	73	102	142	219	276
CHEMICAL	54	80	112	155	180
NON MET MIN.	86	132	174	223	246
FOOD & BEV.	138	157	188	229	255
MISC MANUF	61	88	112	165	229
TOT MANUF	573	784	1053	1424	1679
WHOLSL TRADE	254	317	401	506	627
MAJOR TRANS	1541	1556	1572	1588	1604
OTHER TRANS	314	330	346	363	382
UTILITIES	28	34	40	48	58
TOTAL	2710	3021	3412	3930	4350
DEWDNEY AL.					
FOREST PROD.	266	322	404	508	561
METAL FABR.	9	14	21	33	45
CHEMICAL	4	5	5	6	6
NON MET MIN.	26	25	25	27	26
FOOD & BEV.	14	16	20	25	28
MISC MANUF	25	37	53	81	113
TOT MANUF	344	419	529	680	788
WHOLSL TRADE	14	16	19	24	30
MAJOR TRANS	0	0	0	0	0
OTHER TRANS	23	24	25	27	28
UTILITIES	2	2	3	3	4
TOTAL	383	462	577	735	843
FRASER CHEAM					
FOREST PROD.	137	163	208	247	269
METAL FABR.	14	18	26	48	53
CHEMICAL	132	132	132	132	134
NON MET MIN.	67	68	69	74	72
FOOD & BEV.	53	56	64	75	82
MISC MANUF	21	20	20	21	22
TOT MANUF	424	458	511	589	631
WHOLSL TRADE	36	48	58	62	77
MAJOR TRANS	484	489	494	499	504
OTHER TRANS	381	488	428	441	463
UTILITIES	35	42	50	69	73
TOTAL	1360	1429	1525	1651	1747
G V R D	23984	24571	26114	28114	29273
C FRASER VAL	2710	3021	3412	3930	4350
DEWDNEY AL.	383	462	577	735	843
FRASER CHEAM	1360	1429	1525	1651	1747
TOTAL L.M.	28357	29484	31628	34429	36213

LOWGROWTH SCENARIO

TOTAL LAND REQUIREMENTS
IN ACRES

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	1943	1930	2007	2032	2060
METAL FABR.	1210	1161	1202	1219	1236
CHEMICAL	1912	2022	2235	2167	2084
NON MET MIN.	522	522	556	575	580
FOOD & BEV.	649	641	676	698	738
MISC MANUF	972	1092	1143	1233	1313
TOT MANUF	7208	7326	7818	7924	8011
WHOLSL TRADE	2582	2586	2852	3056	3269
MAJOR TRANS	9214	9386	9399	9493	9588
OTHER TRANS	1876	1978	2068	2172	2280
UTILITIES	3104	3135	3164	3198	3230
TOTAL	23984	24323	25304	25843	26378
C FRASER VAL					
FOREST PROD.	161	228	301	373	444
METAL FABR.	73	99	132	164	196
CHEMICAL	54	78	104	128	150
NON MET MIN.	86	128	161	184	197
FOOD & BEV.	138	153	175	191	208
MISC MANUF	61	78	104	132	159
TOT MANUF	573	765	978	1171	1355
WHOLSL TRADE	254	309	373	434	501
MAJOR TRANS	1541	1556	1572	1588	1604
OTHER TRANS	314	330	346	363	382
UTILITIES	28	34	40	48	58
TOTAL	2710	2994	3309	3605	3899
DEWDNEY AL.					
FOREST PROD.	266	315	376	437	504
METAL FABR.	9	13	19	25	32
CHEMICAL	4	5	5	5	5
NON MET MIN.	26	24	23	22	21
FOOD & BEV.	14	16	19	21	23
MISC MANUF	25	36	58	65	82
TOT MANUF	344	409	491	575	667
WHOLSL TRADE	14	15	18	21	24
MAJOR TRANS	8	8	8	8	8
OTHER TRANS	23	24	25	27	28
UTILITIES	2	2	3	3	4
TOTAL	383	451	538	624	724
FRASER CHEAM					
FOREST PROD.	137	159	186	212	241
METAL FABR.	14	18	24	30	37
CHEMICAL	132	132	132	132	132
NON MET MIN.	67	64	64	61	58
FOOD & BEV.	53	55	59	62	67
MISC MANUF	21	28	19	17	16
TOT MANUF	424	458	484	514	551
WHOLSL TRADE	34	39	46	53	61
MAJOR TRANS	484	489	494	499	504
OTHER TRANS	381	488	428	441	463
UTILITIES	35	42	50	60	73
TOTAL	1368	1428	1494	1568	1651
G V R D	23984	24323	25304	25843	26378
C FRASER VAL	2710	2994	3309	3605	3899
DEWDNEY AL.	383	451	538	624	724
FRASER CHEAM	1368	1428	1494	1568	1651
TOTAL L.M.	28357	29189	30645	31642	32652

1981 INDEX VALUES SCENARIO

TOTAL LAND REQUIREMENTS
IN ACRES

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	1943	1752	1665	1782	1534
METAL FABR.	1210	1055	1000	1173	1170
CHEMICAL	1912	1873	1926	1992	1855
NON MET MIN.	522	471	460	503	505
FOOD & BEV.	649	587	571	619	621
MISC MANUF	972	954	967	1141	1259
TOT MANUF	7208	6693	6688	7131	6945
WHOLSL TRADE	2582	2333	2346	2551	2753
MAJOR TRANS	9214	9386	9399	9493	9588
OTHER TRANS	1876	1978	2068	2172	2280
UTILITIES	3104	3135	3144	3190	3230
TOTAL	23984	23437	23579	24546	24796
C FRASER VAL					
FOREST PROD.	161	207	256	331	370
METAL FABR.	73	91	114	178	209
CHEMICAL	54	73	93	127	152
NON MET MIN.	86	116	138	175	196
FOOD & BEV.	138	140	152	180	196
MISC MANUF	61	71	91	130	171
TOT MANUF	573	698	843	1112	1293
WHOLSL TRADE	254	280	314	384	461
MAJOR TRANS	1541	1556	1572	1588	1604
OTHER TRANS	314	330	346	363	382
UTILITIES	28	34	40	48	58
TOTAL	2710	2897	3118	3496	3797
DEWDNEY AL.					
FOREST PROD.	266	285	318	379	398
METAL FABR.	9	12	16	25	32
CHEMICAL	4	4	4	5	5
NON MET MIN.	26	22	20	20	19
FOOD & BEV.	14	15	16	19	21
MISC MANUF	25	33	43	62	82
TOT MANUF	344	372	417	511	557
WHOLSL TRADE	14	14	15	18	21
MAJOR TRANS	8	8	8	8	8
OTHER TRANS	23	24	25	27	28
UTILITIES	2	2	3	3	4
TOTAL	383	412	461	559	611
FRASER CHEAM					
FOREST PROD.	137	144	157	184	191
METAL FABR.	14	16	20	30	37
CHEMICAL	132	77	80	94	100
NON MET MIN.	67	68	54	55	51
FOOD & BEV.	53	50	51	58	60
MISC MANUF	21	18	16	15	13
TOT MANUF	424	366	379	436	452
WHOLSL TRADE	36	36	39	46	54
MAJOR TRANS	484	489	494	499	504
OTHER TRANS	381	408	428	441	463
UTILITIES	25	42	58	68	73
TOTAL	1348	1333	1382	1483	1546
G V R D	23984	23437	23579	24546	24796
C FRASER VAL	2710	2897	3118	3496	3797
DEWDNEY AL.	383	412	461	559	611
FRASER CHEAM	1348	1333	1382	1483	1546
TOTAL L.M.	28357	28078	28540	30084	30750

Industrial Development Subsidiary Agreement

Research Report

Province of British Columbia
Ministry of Industry and Small Business Development

Government of Canada
Gouvernement du Canada

Regional Economic Expansion
Expansion Économique Régionale

THE DEMAND FOR INDUSTRIAL LAND IN THE VANCOUVER LOWER MAINLAND

VOLUME II - TECHNICAL REPORT

JANUARY 31, 1983

Prepared for:

THE B.C. MINISTRY OF INDUSTRY & SMALL BUSINESS DEVELOPMENT
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The responsibility for the content of this report is the consultant's alone, and the conclusions reached herein do not necessarily reflect the opinions of those who assisted during the course of this investigation or the Federal and Provincial governments which funded the study.

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INDUSTRIAL LAND DEMAND IN THE LOWER MAINLAND

I. INTRODUCTION & OBJECTIVES

A. INTRODUCTION

There are a number of industrial land issues confronting the four Regional Districts in the Lower Mainland. In a broader context, the B.C. Ministry of Industry & Small Business Development and the Federal Department of Regional Economic Expansion are interested in also understanding the long range implications of Lower Mainland development patterns on the rest of the province. Consequently, the three levels of government agreed to collaborate on a comprehensive study of industrial land in the Lower Mainland.

This document presents the results of a comprehensive study which analyzed the determinants of industrial land demand and forecast industrial land demand in the Lower Mainland by region through 2001. The study was undertaken on behalf of the Ministry of Industry & Small Business Development by Currie, Coopers & Lybrand. The results of the study are presented in three parts:

The results of the demand study are presented in three parts:

The Executive Summary presents a capsule report of the major findings of the study. An overview of the study methodology is presented, followed by a discussion of key determinants of demand for industrial land. Finally, the summary reports on the forecast for industrial land demand in each of the regions in the Lower Mainland.

The Main Report provides a detailed discussion of the study process and results. The Report introduces previous works in the area of forecasting industial land demand, and discusses how this study has attempted to overcome some of the shortcomings of these studies. Building on that discussion, the Report provides a summary of the methodology used to: collect historical land data; determine the key factors which impact businessmen's industrial land decisions; and develop a forecasting model. The main body of the Report presents a detailed discussion of the findings with regard to land and the geographical location requirements issue. The forecast results are presented in detail, outlining the basic economic assumptions used to drive the forecast, the implications of the forecast in a province-wide context, and the resulting land demand in each region. Finally, the report summarizes the key findings of the study, highlighting those points which merit further investigation.

The Technical Report documents the methodology used for data gathering and modelling in more detail. The industry interview program is discussed in detail, as is the forecasting model which was constructed. The Technical Report also discusses ways in which the forecasting model can be manipulated to develop alternative forecasts and to conduct policy analysis. Finally, a number of appendices containing backup documentation and data are included.

II. DATA

This section of the report provides information on sources of data used in this study. This section is broken down into two parts: the first part describes the sources for historical data on land consumption and industrial output; and the second part describes the interview program used to generate industry-specific information on the manner in which companies make decisions on how much and where to purchase land.

A. DATA COLLECTION - HISTORICAL LAND USE AND OUTPUT

This part of the report briefly describes the land use data and industrial output data which have been used as the basis for analysis in this study.

1. Land Use Data

Land data for the 23 sectors which comprised the Project One inventory conducted by the four Lower Mainland regional districts form the basis for the land use data in this study. These data have resulted from field surveys by all four districts in keeping with the Standard Industrial Classification (SIC) categories at the two-digit level. Finer breakdowns (three-digit level), as well as site specific information for each land parcel (eg. site coverage), comprise the backup information used in the Project One exercise. As reported by each regional district which supplied the data, the data have the following characteristics:

- They are on an "as used" basis, rather than zoned or planned.
- They are on a legal parcel basis. Namely, the presence of a given industry on any portion of a legal parcel is sufficient to enable the entire parcel to be categorized according to that use.

In the case of the GVRD, the land data have been supplied under the Land Use Information System (LUIS). The categories according to that system should be congruent with the Project One output in terms of the higher level of aggregation used in this study.

The table on the facing page lists the 10 sectors used in this study, describing the major contents of each, and the Project One sectors which have been included in each.

The choice as to which Project One sectors should be aggregated together was made based on industry interview findings. By and large, the 10 sectors provide homogeneous groupings of industries from a land use planning perspective. It is expected that planning decisions would not be approached differently for any of the various industries within each category. The extent to which this is not true did not warrant the "stretching" of existing data given two major problems concerning availability of data.

The first problem concerns the availability of historical data on industrial land use. The only comprehensive source of historical data prior to 1981 was available under the GVRD LUIS system. These historical data were needed to analyse trends in changing land use patterns, and therefore a modified version of the LUIS categories was used, subject to the constraint of maintaining compatibility with the Project One data. The second constraint is related to historical data on industrial output in the province, and this issue is discussed in Part 2 of this section, immediately following.

Appendix I of this report contains the detailed data broken out on a Project One basis as supplied by each of the regional districts. The Appendix also contains the same data aggregated to the ten sector basis used in this study. This allows for cross-reference between the two levels of aggregation.

2. Output Data

Since the density measure used in this study is output per unit of land, output data were required in some detail. Output statistics based on the values of shipments by industry sectors are available for the manufacturing industries from Statistics Canada's Census of Manufacturing. This census is taken every year, and data are also available for municipalities (Catalogue 31-209, "Manufacturing Industries of Canada: Subprovincial Areas"). Thus, shipment values for each of the manufacturing industry groupings identified earlier were gathered for 1976 and 1979, the latest year for which such data are currently available. The 1979 data were then projected to 1981, by examining both the trend growth for the years between 1976 and 1979, and by validating these estimates by examining Catalogue 31-001, "Inventories, Shipments and Orders in Manufacturing Industries" which provide preliminary 1981 non-census output data for these industries.

As mentioned, these data exist by municipality. Shipment values for the four regional districts were derived by aggregating the municipal data relevant for each regional district.

In some smaller municipalities, output data exist for only some of the industry gorupings. This is due to the confidentiality restriction that Statistics Canada has to observe: for small regions, certain data have to be suppressed to preserve the anonymity of the data source. In such instances, the output data for these sectors in these regions were imputed by examining the industrial composition of the region, and by identifying all of the major establishments in these sectors in the region. In some cases, these estimates could be checked against information gained during the interview process. The final estimates reflect the relative magnitudes of various activities in various regions, using the regions which do have published data as benchmarks. This imputation process, although judgemental, should not

significantly affect the reliability of the data base, as most of the sectors requiring this type of estimation comprised very small shares of industrial land in that region.

For the Wholesale Trade sector, data on the "volume of trade" for wholesale merchants for B.C. are available from Statistics Canada's Catalogue 63-601, "Merchandising Business Survey: Wholesale Merchants". Again, data are only available for 1979, and a trend growth rate was applied to obtain 1981 data.

The wholesale data do not provide regional breakdowns within B.C. Thus, data for the regional districts were derived by allocating the provincial data according to employment distribtuion. Wholesale trade employment data for the Lower Mainland were obtained from the Centreal Statistics Bureau of the B.C. Government. For the four regions within the Lower Mainland, allocators were generated by the study team by examining the employment records of the major wholesale establishments within each district.

The above procedures provided a set of output data for the seven industry groups which were modelled. However, these data were in current dollars. The data were then expressed in 1981 constant dollars by using the corresponding Industry Selling Price Indexes from Statistics Canada.

One anomaly should be noted. Because the data used are shipments and volume of trade data, not value-added data, the relative magnitudes of the outputs of various industries may appear distorted. This is especially so for the Wholesale Trade data. The volume of trade statistics will include the <u>total</u> values of goods wholesaled, such as cars and machinery. The bulk of such values are the <u>costs</u> of these goods as imported, bought, or traded among the wholesale merchants. Thus, the wholesale trade data will appear unusually large.

Despite the above comments, the shipment and volume of trade data were used for two reasons:

- data availability, and
- the relevance of such data.

The relevance issue refers to the objective to measure the production activities on land. While purchased inputs should not be counted as "outputs" in an economic accounting exercise, (that is, value-added rather than shipments should be used), these purchased inputs do occupy physical space and should be included in a land forecasting context. If a physical unit has to be moved to three different locations in the production/sales process, required space is three times as large, even if no real output has occurred in an economist's strict sense of the word.

This reasoning and study methodology must be juxtaposed with the fact that the CSB has provided economic forecasts in the economist's more strict definition of output, namely value added (Gross Domestic Product). Consequently, the levels of output as expressed in CSB forecasts (and historically in GDP data) do not correspond to the "output" data used for this study. However, it is reasonable to assume that the ratios between GDP and shipments will remain relatively constant over time, and therefore forecasted growth rates in GDP can be used directly in this study as growth rates in shipments.

3. Density Data

Hisotrical density data were obtained by dividing the land data into the output data. Because GVRD is the only district for which 1976 land data are available, proportional changes in densities between 1976 and 1981 are assumed for the other three regions. Further, it should be noted that the regional districts

outside of the GVRD provided 1982 land data. Consequently, the 1981 densities for these regional districts are technically hybrids of 1982 land data and 1981 output data. However, since the 1982 land data were actually collected and published in late 1981 and early 1982, they reasonably reflect an end-of-year 1981 position, and therefore are reasonable to use in this way.

B. DATA COLLECTION - CORPORATE DECISION STRUCTURE

The series of interviews conducted with corporate decision makers served two purposes. First, the interviews identified the key factors which impact business decisions on the amount of industrial land to be consumed, and where inside British Columbia to locate specific facilities. Second, once the appropriate factors were identified, the interviews provided the data needed to quantify these relationships.

In total, 56 company interviews were conducted. Companies were chosen to provide a broad cross-sampling of industry sectors by company size and regional representation. Although the study focused on the intra-regional location decisions for companies inside B.C., a number of interviews were conducted outside of the province to test whether the issues identified as being important within the province also had validity in a broader geographical context. Based on a limited set of out-of-province interviews, this assumption was borne out. Table 2 provides a breakdown by location and by industry sector of the 56 interviews conducted.

1. Development of the Questionnaire

Prior to the execution of the interview program, four important steps were carried out.

- Initial assumptions regarding the manner in which land decisions are made were tested in approximately 10 telephone

interviews. Based on the findings of these interviews, original assumptions were modified and a preliminary interview questionnaire was developed.

- Industrial directories were used to produce a comprehensive list of companies in the Lower Mainland, and a target group of companies was chosen to give the necessary diversity of interviews.

- The target companies were contacted by telephone. Following an explanation of the nature of the information required, the appropriate decision-maker was identified and an interview time was set up to allow for uninterrupted discussion lasting approximately two hours. In the few cases where an interview could not be set up, a substitute company was identified and contacted.

- Following execution of the first six interviews, the study team conferred on ways in which the interview process could be modified to better capture the information required. The revised material was used for all subsequent interviews.

2. Description of the Interview Process

As noted, interview candidates were asked to set aside approximately two hours in which to conduct an in-depth interview regarding their company's demand for industrial land. At the outset of the interview, the interviewer again provided a brief introduction to the study objectives and study sponsors. In order to improve the probability that the intereview would be fruitful, companies were told that this provided an opportunity for them to air their wiews. Also, while the confidentiality of interview results was assured, interviewees were promised some feedback on aggregate study results. Interviewees were given an opportunity to ask general questions, which were followed by

administration of the interview questionnaire. A copy of the final version of the questionnaire is contained in Appendix III.

The questionnaire was divided into two sections. The first section deals with the question of how much land is needed for a given facility. The second section deals with the regional location decision.

Questions 1 and 2 of the questionnaire ask for specific details on existing industrial sites. These data were valuable in checking the validity of aggregate industry coefficients, and perhaps more importantly, on land density giving an appreciation of the amount of industrial land held in inventory for future expansion. Some interview candidates had obvisously prepared for the interview as evidenced by the fact that they had all of the information requested in these first two tables readily at hand. In these cases, the tables were filled out on the spot. Otherwise, the forms were left with the interviewee to be filled out and returned at their convenience.

Questions 3 through 8 were specifically worded to be open-ended probes into the interviewee's decision-making structure regarding the amount of land needed. These questions identified the factors most important to the interviewee, and provided a general insight into the way in which the interviewee approached the decision-making process.

Question 9 then asked the interviewee to rank each of the factors identified on a scale from 0 to 10. This form was always filled out on the spot. When this question was asked, it was pointed out to the respondent that the question does not include space to rank an "output" factor in terms of its influence on land demand. The question assumes a decision has been made to buy land based on production requirements, and is looking for a response on how

that decision would then be adjusted (ie. how does density change?).

Questions 10 through 12 shifted the interview to the question of location decisions. Question 10 was open-ended, asking the interviewee to list important location factors. Question 11 gathered information on the way in which each of the factors affected the location decision, and Question 12 asked for a ranking of each factor on relative importance on a scale from 0 to 10.

Questions 13 through 15 gathered specific information on the four Lower Mainland regions and the rest of the province in terms of their relative attractiveness. Question 13 was open-ended, asking for general comments on the regions, followed up by Question 14 which had the interviewee rank each of the regions in terms of their current attractiveness, again on a scale from 0 to 10.

Question 15 asked the user to rank the current condition of each location factor in each region. Some interviewees claimed total ignorance of conditions in some of the regions, and in these cases the forms for those regions were not filled out. Responses to Question 15 were used to test whether or not a respondent's rating of the factor conditions in each region weighted by the relative importance of each factor, produced variations in regional attractiveness scores which matched the rankings given in Question 14. Obvious inconsistencies were discussed with the interviewee, resulting in revisions to some or all of the weighting factors, current factor condition scores, or overall region attractiveness scores.

3. Success of the Interview Program

The vast majority of the interviews carried out proceeded to a favorable conclusion. That is to say, the interviewer was able to illicit responses to virtually all of the questions, and at the end of the process the interviewee felt that the discussion covered the basic issues important to both the regional location decision and the land density decision.

In a few notable exceptions, part way through the interview, it became clear that the interviewee was unable to articulate or conceptualize regarding industrial land requirements. In those cases, attempts by the interviewer to determine the framework used for making industrial land decisions were unsuccessful.

As noted previously, Question 15 which asks for specific attractiveness rankings of the location factors in each region met with some resistance. To help overcome this problem, the interviewee was given the option of ranking a specific location within any of the regions. This was often useful in overcoming the interviewee's feeling of knowing "nothing about that region".

III. MODEL STRUCTURE

Based on the information gathered during both phases of data collection, a computerized forecasting model was developed. The model forecasts total industrial land required, broken down by ten industry sectors in four regions of British Columbia. The study focussed on the Lower Mainland, and therefore the four regions modelled are:

- Greater Vancouver Regional District (GVRD)
- Central Fraser
- Dewdney Alouette
- Fraser-Cheam

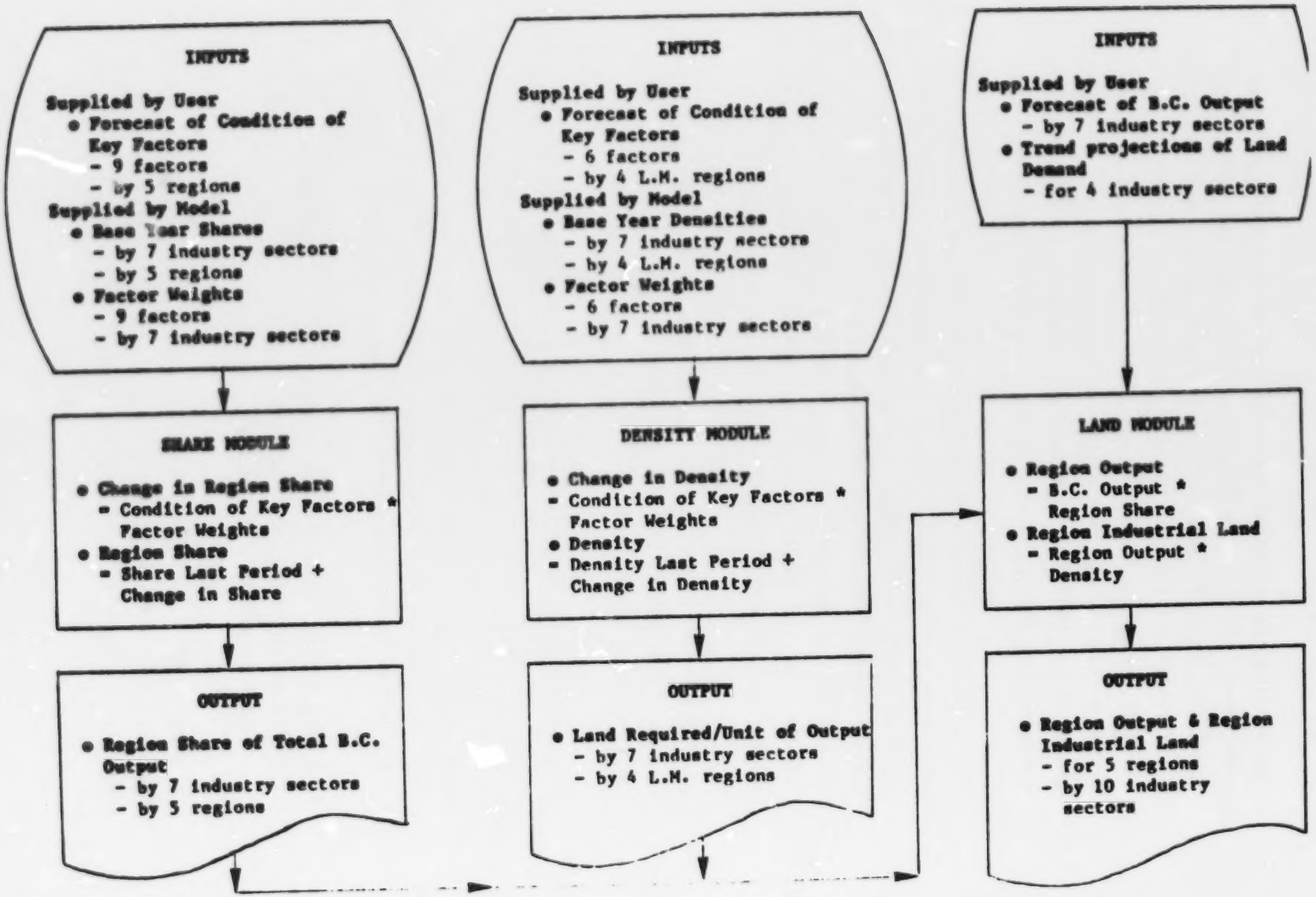
The 10 industry sectors which were broken out for each of the regions are:

- Forest Products
- Metal Fabrication, Primary Metal
- Chemicals, Petroleum Products
- Food and Beverage
- Non-Metallic Mineral Products
- Other Manufacturing
- Wholesale Trade & Storage
- Major Transportation Services
- Other Transportation & Storage
- Utilities

The analysis of industrial land needs and the resulting forecasting model which was built use regional output share by industry and land density (the amount of output per unit of land) by industry, as the cornerstones for producing forecasts for industrial land demand. This analytical framework was used for the six manufacturing industries and Wholesale Trade and Storage. In the case of the other three industries (Major Transportation Services, Other Transportation and Storage, and Utilities), this approach could not be used for two reasons. First, no

Chart 1

SCHEMATIC OF THE FORECASTING MODEL


INPUTS
Supplied by User
• Forecast of Condition of Key Factors
- 9 factors
- by 5 regions
Supplied by Model
• Base Year Shares
- by 7 industry sectors
- by 5 regions
• Factor Weights
- 9 factors
- by 7 industry sectors
SHARE MODULE
• Change in Region Share
= Condition of Key Factors * Factor Weights
• Region Share
= Share Last Period + Change in Share
OUTPUT
• Region Share of Total B.C. Output
- by 7 industry sectors
- by 5 regions
INPUTS
Supplied by User
• Forecast of Condition of Key Factors
- 6 factors
- by 4 L.M. regions
Supplied by Model
• Base Year Densities
- by 7 industry sectors
- by 4 L.M. regions
• Factor Weights
- 6 factors
- by 7 industry sectors
DENSITY MODULE
• Change in Density
= Condition of Key Factors * Factor Weights
• Density
= Density Last Period + Change in Density
OUTPUT
• Land Required/Unit of Output
- by 7 industry sectors
- by 4 L.M. regions
INPUTS
Supplied by User
• Forecast of B.C. Output
- by 7 industry sectors
• Trend projections of Land Demand
- for 4 industry sectors
LAND MODULE
• Region Output
= B.C. Output * Region Share
• Region Industrial Land
= Region Output * Density
OUTPUT
• Region Output & Region Industrial Land
- for 5 regions
- by 10 industry sectors

output data are available for these sectors on a regional basis or in some cases even on a provincial basis. Second, and perhaps more important, these sectors are essentially mixed use sectors, and not specifically industrial. Demand for land for airports, bus depots, used car lots, telephone switching stations, and ports to name a few, are driven by factors that are neither strictly industrial, nor restricted to growth of the Lower Mainland economy. Therefore, they are treated separately, allowing for user input directly on land demand.

While the model focusses on land demand in the Lower Mainland, for completeness it was highly desirable to also model the "Rest of B.C." as a region competing for share of industrial output. Consequently, the model produces forecasts of output share and total output for the rest of B.C. as well as for the four Lower Mainland regions. However, since no data on total industrial land in the rest of B.C. were available, land demand for this fifth "region" was not modelled.

Determination of demand for industrial land was modelled as a three-stage process. A schematic of the model structure is contained in Chart 1. The three modules are:

- a Share Module, which determines shares of total output by industry in each region as a function of region attractiveness,

- a Density Module, which determines the amount of land needed for a given sized facility or expansion (density) by industry as a function of the key determinants of density, and

- a Land Module, which determines the amount of land needed in each region and industry as a function of density, total provincial economic activity, and region share of output.

The reasons for breaking the model down into three modules are twofold. First, a three-stage model provides explicit information to the user regarding the ways in which overall economic activity, relative region

attractiveness, and intensity of land use, each affect industrial land demand. Second, the segmented model gives the user greater ease in developing forecasts and analyzing "what ifs" and specific policy questions. While it is understood that each of the three decision stages are highly interdependent, the interview process confirmed that this modelling framework does not significantly distort reality.

This section describes each of the three modules in some detail. It deals first with the Land Density Module, next the Location Module, and finally the Output/Land module.

A set of notation conventions will be used throughout the discussions of each module. Four variable subscripts are used. These are:

- i refers to the industry sector
- j refers to the region
- t refers to the time period. The model forecasts in five year intervals, hence t-1 refers to five years prior to period t.
- k refers to the factor counter. For the density module, k ranges from one to six for each of the six factors, while in the case of the location module, k ranges from one to nine since there are nine factors explaining location.

Two additional notation conventions are used. These are:

- Δ which means "change in"
- $\sum_{k=1}^{6}$ which means the sum of all values following the symbol. In the case of this example, it would mean summing six computed values, sequentially substituting 1 through 6 into the k counter position of the variable in the formula.

Finally, two terms are used throughout this section and the next:

- Endogenous variables are those which are solved for in the model. In other words, they appear on the left hand side of an equal sign somewhere in the system of equations.

- Exogenous variables are those which are not solved for in the model, but have values set "outside" the model and are input by the user. These variables never appear on the left hand side of an equal sign.

In this context, it should be noted that wheras an exogenous variable can never show up on the left hand side of any equation, once an endogenous variable has been solved for in the model, it may subsequently be used as an input value in another equation later on in the system.

A. THE LAND DENSITY MODULE

As noted in Section III of the main report, land density is defined as the level of real output (stated in 1981 constant dollars) divided by the number of acres of industrial land. The density module solves for land density on a rate of change basis. Specifically, for any of the Lower Mainland regions, for each of the six manufacturing sectors modelled and for the wholesale trade sector:

$$\text{Density}_{i,j,t} = \text{Density}_{i,j,t-1} * \Delta\,\text{Density}_{i,j,t}$$

The change in density has been modelled in the following terms:

$$\Delta\,\text{Density}_{i,j,t} = a_{i,j} * \sum_{k=1}^{6} (\text{Factor Weight}_{i,k} * \text{Factor Condition}_{j,k,t})$$

Where:

- a_{ij} is the base level density change factor for industry i in region j. In other words, if forecast values for each of the

factor conditions in any future year are all set at 1.0, the change in density in that period would be equal to $a_{i,j}$.

- k is the counter on the factor (eg. land purchase price, interest carrying costs, etc.).

- Factor Weight$_{i,k}$ is the relative importance weighting for factor k in affecting density as derived from the interview process. These factor weights are specific to each industry sector i, and are normalized to sum to 1.0 for that industry. It should be noted that the Factor Weights for a given industry are assumed to remain constant over time and across regions. In other words, it is the change in the Factor Conditions themselves (and not the Factor Weights) over time and across regions which will influence the rate of change of density.

- Factor Condition$_{j,k,t}$ is the actual value given to the factor k in region j in period t. These factors are the exogenous variables which drive this section of the model. Units of measurement for each of these factors in absolute terms, are different and in the case of some factors such as gross-up requirements, there are no obvious units of measurements at all. Hence, a decision was made to input these Factor Conditions as index values. A value of 1.0 is assumed to mean that the factor remains at its 1981 base level. A value of 1.1 for a factor condition would imply a 10% improvement in that condition as compared to its 1981 level.

  "Improvement" in a condition is defined to mean a change in that condition which will be perceived as advantageous to business. In the case of land costs, interest costs, tax rates, and gross-up requirements, a reduction in the rate of increase of these variables would be an improvement. In the case of technology change and the changes in the capital/labour ratio, an improvement

would mean an increase in the rate of change since change is assumed to be implemented only if it is to business' advantage. As will become clearer once the Share Module has been explained, this strict convention of using a value greater than 1.0 for an improvement (even if the improvement is a decline in value) avoids confusion for the model user.

Since an improvement in land costs, taxes, and interest costs will tend to slow the rate of density change (e.g. relatively lower land costs exert less pressure on the need to intensively use land) the model uses the reciprocal value as input by the user for these Factor Conditions before computing Density.

Of the six factors, three are not region specific: interest carrying costs; technology changes; and the capital/labour ratio. Interest carrying costs are a function of interest rates which are uniform across the country. Technology changes and changes in the capital/labour ratio are assumed to be global issues, and therefore not impacted by regional location. Consequently, the Factor Condition forecasts for these three variables are input on a province wide basis.

The density values solved for in this module are then stored to be subsequently transferred to the Output/Land Module. Prior to solution of the Output/Land Module, however, the Location Module must be solved.

B. THE LOCATION MODULE

This module has actually been subdivided into two sub-modules, since the Apple II Computer does not have sufficient core space to solve this module all at once. The first sub-module solves for regional attractiveness scores, and the second sub-module uses the regional attractiveness scores to solve for regional output shares.

Description of the module will follow the progression through these two sub-modules.

1. Regional Score Sub-Module

This sub-module solves for regional attractiveness scores using the following formula:

$$\text{Region Score}_{i,j,t} = a_{i,j} * \sum_{k=1}^{9} (\text{Factor Weight}_{i,k} * \text{Factor Score}_{j,k,t})$$

Where:

- $a_{i,j}$ is the base score coefficient for industry i in region j. In other words, if all index values are left at the 1981 base value of 1.0, the region score is equal to $a_{i,j}$.

- k is the counter on the condition variable (eg. relative land costs, proximity to markets, etc.). There are nine factors.

- $\text{Factor Weight}_{i,k}$ is the relative importance weighting for variable k as it influences loction decisions as derived from the interviews. The Factor Weights are industry specific, and are normalized to sum to 1.0. They are assumed to remain constant over time and across regions. As with the Density Module, it is changes in the Factor Conditions and not the Factor Weights which change the outcome.

- $\text{Factor Condition}_{j,k,t}$ is the value of condition k in region j in period t. As with the density module, since there is no obvious choice of unit measures for many of these factors, factor conditions are input as index values, where 1.0 is the 1981 base value for each condition. A value of 1.1 for any factor would imply an improvement in that Factor Condition by 10%. Conversely, a value of 0.9 would imply a deterioration in that condition (in that region and time

period) of 10%. It is important to note that unlike the Factor Weights, the Factor Conditions are not assumed to be industry specific. As noted in the segment describing the Density Module, a convention has been maintained for the the entire model that an improved condition receives a value in excess of 1.0.

It could be argued that certain conditions should be assumed to be industry-specific (eg., government grants could be directed at a specific industry sector) however the added number of variables to be manipulated if this condition were relaxed would make the model excessively cumbersome. Since there are nine factors for five regions for four forecast time periods, a model-user would have to input 180 forecast values in order to run the model.

Results from this sub-module are stored for immediate transfer into the second sub-module.

2. Output Share Sub-Module

This sub-module strongly resembles the land density module in its structure. It is modelled on a "change" basis. Specifically,

$$\text{Output Share}_{i,j,t} = \text{Output Share}_{i,j,t-1} + \Delta\text{Output Share}_{i,j,t}$$

Where Change in Output Share has the following form:

$$\Delta\text{Output Share}_{i,j,t} = (\text{Average Regional Score}_{i,1981}/\text{Average Regional Score}_{i,t})\, a_{i,j} * (\text{Region Score}_{i,j,t} - \text{Region Score}_{i,j,1981})$$

Where:

- Average Regional Score$_{i,1981}$ is the average regional score in industry i, across all five regions, in 1981 (the "base" year).

- Average Regional Score$_{i,t}$ is the average regional score in industry i, across all five regions, in period t.

The purpose of the ratio in the first half of this equation is to capture a level effect on regional location influences. Specifically, it means that the change in region shares will be greater if the average scores in period t are lower than in the base year, and the change in share will be greater when average scores improve overall. This term is included because regional location decisions are made on a comparative basis between regions. Consequently, one would expect to see more relocation when province-wide conditions have deteriorated, pushing management to find even a marginally better location. On the other hand, if overall conditions have improved, there is less motivation to seek the optimal region when the region in which one is already operating has improved in its own right.

- $a_{i,j}$ is the base level region share coefficient. It is similar in concept to the $a_{i,j}$ in the Density Module. Since the equation structure in this module is slightly different than in the case of the Density Module, it is not true that $a_{i,j}$ is mathematically equal to the percentage change in output share where all factor conditions are set at a 1.0 value. However, this is a function of the mathematical formulation, and does not change the basic conceptual notion that this coefficient determines the base level share change.

In actuality, $a_{i,j}$ is a compound value set mathematically to satisfy two conditions: First, it satisfies the previous point that it results in base level share change when all

Factor Conditions are set to 1.0. Second, it sets the "cross-over" region score at which a region which has been gaining share in an industry sector will now lose share, and vice versa.

For regions which are currently losing share, it is assumed that a 50% increase in the current region score would be necessary to put the region in a net even share change position. In other words, if a region has an attractiveness score of 8.0 in the food processing sector and is gaining share, while a drop in score to 6.0 will slow down the rate of share gain, not until the region drops below 4.0 will it actually begin to lose share.

- $(\text{Region Score}_{i,j,t} - \text{Region Score}_{i,j,1981})$ is the change in the Region Score for industry i in region j in period t as compared to the value in the base year 1981. In other words, for a region gaining share, an improvement in the score produces a positive value, which when multiplied by $a_{i,j}$ increases the share gain. If the region score deteriorates below 1981 levels, this term becomes negative. Given the previous note on the compound structure of $a_{i,j}$ in this equation, it is important to bear in mind that a negative value for this Region Score difference term first reduces the rate of share gain, and only if the difference surpasses the 50% deterioration rule does the region actually begin to lose share. For a region in a base position of losing share, the logic is exactly reversed.

The numerical specification of this equation is somewhat cumbersome, and has therefore been omitted in its exact mathematical form. The preceding discussion and notation are conceptually accurate and complete, and mathematically accurate to the level of detail chosen. For a more rigorous mathematical

notation of this module the reader is referred to Appendix IV.

Essentially, this equation structure for share change attempts to capture two effects. First, as overall conditions improve, one would expect less dramatic changes in share re-allocations, whereas a general deterioration in business conditions would increase the rate of change of shares. Second, the rate at which a region will gain or lose market share in any industry is also a function of how a region's score changes relative to its base value.

The one additional refinement to this sub-module is that share changes are necessarily constrained to sum to zero for any industry across all regions. This constraint is needed to ensure that total output of the regions always sums to 100% of total provincial output. If the region share equations produce numbers which do not perfectly sum to a net change of exactly zero, the initial share change values across regions are pro-rated to satisfy this constraint.

The output share results from this second sub-module are then stored to be transferred into the Output/Land Module.

C. THE OUTPUT/LAND MODULE

This module combines the results of the previous two modules, and solves for regional output and regional industrial land requirements. The user inputs forecast values for growth in output (measured in 1981 dollars). Total provincial output is then solved for:

$$\text{Provincial Output}_{i,t} = \text{Provincial Output}_{i,t-1} * (1 + \text{Growth Rate}_{i,t})$$

Regional output levels are then solved for. The equation specification is:

$$\text{Regional Output}_{i,j,t} = \text{Provincial Output}_{i,t} * \text{Output Share}_{i,j,t}$$

Once regional output has been solved for, land requirements can be determined by combining output values with density values. Specifically:

$$\text{Land Required}_{i,j,t} = \text{Regional Output}_{i,j,t} \ / \ \text{Density}_{i,j,t}$$

Note than since density is expressed as output per acre, output is divided by the density measure in order to solve for acres of land required.

The preceding discussion provides a mix of a rigorous detailing of exact equation forms and coefficients with a more descriptive discussion of the reasons why the model has been structured in the way it has. Section IV, immediately following, provides guidance on how the model can be used to produce alternative forecasts. Appendix V provides a listing of the exogeneous and endogeneous variables for each module.

IV. MODEL MANIPULATION

APPLE Visicalc has been chosen to implement the land forecasting model primarily because of its portability and low cost. However, owing to memory limitations in the standard APPLE II configuration on the one hand, and the size of the computational problem on the other, it was necessary to spread the model over five Visicalc "modules". These consist of:

1. DMOD, the density module, which accepts data on the regional conditions of the determinants of density, and produces estimates of density by industry, region, and forecast year;

2. SMOD.A, the first share module, which accepts data on the regional conditions of the output share determinants, and computes regional attractiveness scores;

3. SMOD.B, the second share module, which accepts results from the first share module, and produces estimates of output share by industry, by region; and

4. SUMMOD, the summary module, which accepts results from DMOD and SMOD.B, invites user entry of forecasts for industry output and residual-industry land growth rates and computes land requirements, (aggregated and disaggregated) by forecast year.

5. REPMOD, which is simply a report writer which takes land data from SUMMOD and produces a set of reports on growth rates, etc.

Part A of this section briefly discusses the exogeneous variables which can be changed in each module in order to produce alternative forecasts. Part B of this section explains how to use the forecasting system on the APPLE II.

Formatted hard-copy reports listing input data and results may be produced at any stage, and these are also explained in part B.

A complete set of example reports from each module are contained in Appendix VI, and their "corner parameters" vis-a-vis matrix location within the modules is given to facilitate easier use of the modules and easier printing of the reports.

A. DEVELOPMENT OF ALTERNATIVE FORECASTS

1. The Density Module (DMOD)

In the case of the density module, the user can produce alternative scenarios by adjusting the input values of the six factor conditions which affect density:

- land purchase price,
- interest carrying costs,
- property taxes,
- technology change,
- capital/labour ratio change, and
- gross-up requirements.

As discussed in Section III, forecast values for these factors are input as index numbers, with all factors based at a value of 1.0 in 1981.

It is important to note that these condition variables do not represent the current level of that condition, but rather the rate at which the condition has been changing during the five-year period. In other words, a forecast value of 1.0 in 1986 for land price would not mean that the land price is

expected to be identical to the price observed in 1981, but rather that the rate of increase in the price from 1981 to 1986 will be similar to the rate of increase observed from 1976 to 1981. This concept holds for all of the input values.

As noted in Section III, land price and property taxes can be input as region-specific factors, whereas the other four conditions receive input values on a province-wide basis only. This is because factors such as interest rates and technology change are assumed to be independent of region location.

A value of greater than 1.0 implies an improvement in the condition of the variable and a value of less than 1.0 implies deterioration in the condition. As discussed in Section IV of the Main Report and Section III of this report, an improvement in land costs, interest costs, and taxes implies a decrease in density, whereas an improvement in the rate of change of technology, the capital/labour ratio, or gross-up requirements implies an increase in density gains.

2. The First Share Module (SMOD.A)

The first share module (SMOD.A) calculates the region scores for each industry. The user can develop alternative forecasts for region scores by changing input values for the factor conditions for each of the nine factors in the model:

- relative land cost (as compared to other regions),
- property taxes (operating costs),
- distance from markets served (which could conceivably change if the location of the markets shifts),

- adequacy of transportation infrastructure (including roads, rail and water routes),
- land availability,
- availability of local labour supply (skilled and unskilled),
- proximity to raw materials,
- government grants (on other government support), and
- lifestyle.

As discussed previously, factor conditions are indexed to a 1981 base value of 1.0. Unlike the density module, however, factor scores in this module are input based on their current condition rather than the rate of change in the condition. In other words, a value of 1.0 for distance from markets served for GVRD in 1986 would mean that there has been no change in GVRD's position relative to markets from the 1981 period. The two exceptions to this convention are for relative land costs and property taxes, where the user inputs values on a rate of change basis, similar to their treatment in the Density Module. In this way, if a user inputs a value of 1.2 for relative land costs in the Density Module, this value can be replicated in the Share Module to avoid any potential confusion.

In this module, an improvement in any condition has the impact of improving the region's score for all industries. The amount of the improvement for each industry in the region is a function of the factor weighting for that condition for that industry.

3. The Second Share Module (SHOD.B)

The second module within the share forecasting system, SHOD.B, produces regional output shares by industry based on the regional scores provided through simulation of SHOD.A. As noted, the only

reason for a second share module in the system is that the memory core of the APPLE II cannot accommodate the full Share Module at once. Consequently, there are no exogenous variables in this second Share Module. Once the user loads the results of SMOD.A, this second module can be immediately solved to produce regional output shares by industry.

4. The Summary Module (SUMMOD)

This module takes the density results and region share results and marries them with assumptions on total industry output to arrive at regional output and regional land forecasts.

Future industrial land demand is significantly affected by future growth in output. Changing the assumptions on total economic activity in B.C. is an important way in which model users can produce as an important way in which model users can produce alternative land demand scenarios. The model user should keep in mind that the Summary Module obviously assumes that regional allocation of output will be distributed according to the results obtained from the share module: changing the total output forecasts for one sector on a province-wide basis will not affect regional shares of output for that industry sector. However, since the industrial mix within each region is considerably different, changing the rate of growth of any of the industry sectors will not have identical impact on total output for each of the regions or total land demanded for each of the regions.

This module also takes user inputs on rates of growth in industial land demand for each of the three sectors not modelled on a density and region share basis: Major Transportation, Other Transportation, and Utilitites. For these industries, alternative forecasts are developed by directly changing the rate of growth in land requirements for those industries for those regions. The results of these changes will be reflected in land

demand for those sectors and also in total land demanded for the regions in which the changes have been made.

This module is essentially nothing more than a set of identities. Other than through changes to the growth rate assumptions, it does not allow the user any flexibility in influencing the model results. Beyond these changes, if the user wishes to produce a different forecast, it can only be done by going back to either one or both of the Density and Share Modules to produce different intermediate results. Again, this is of course aside from producing alternative forecasts based on alternative total production forecasts for the province, which can obviously be changed within this module.

5. The Reporting Module (REPMOD)

This module takes the land results from SUMMOD for the seven sectors modelled on a density and share basis and for the three sectors modelled on a rate of growth basis and consolidates the information for reporting. The module then produces total region reports on land demand, share of land demanded by each industry sector in each region, and rates of growth in land demand.

Given the preceding discussion on ways in which the model can be used to produce alternative forecasts, the next part of this section describes the mechanics in some detail for accomplishing any of these changes.

B. MODEL MANIPULATION

The following instructions assume an elementary knowledge of Visicalc. The user may nevertheless wish to consult those portions of the Visicalc manual describing the storage and print commands (/S, L/, and /P), which are employed extensively in the present system.

It is important to note that since some data are stored in a 'DIF' format, a Visicalc initialized disc cannot be used with this system. The disk supplied with the report has been appropriately initialized, but if the user runs into space constraints, the following procedures must be followed to initialize additional disks. First, 'boot' the system using SYSTEM MASTER. Then insert the model disk and execute:

LOAD HELLO

Then insert a new disk into the drive and execute:

INIT HELLO, D1

The system must then be shut down and 'booted' v in Visicalc again.

After loading the Visicalc program, insert the land forecasting diskette and perform the following steps.

1. Solving the Density Module (DMOD)

   Load the density module by executing:

   /SL DMOD

   Now scroll down to A12 and enter data on the determinants of density. Once entered, the data should be saved t' e first time by executing:

   /SS DMOD <RET> Y

   This will replace the original DMOD. On other occasions, one may wish to substitute another file name in order to preserve an existing data specification. Although several versions of DMOD may be accumulated in this way, the experienced user may prefer to store density data sets more compactly by utilizing the /S#

command to save or load only the DMOD data section (see the Visicalc manual).

Once the factor values have been entered, the module can be solved. Next, move the cursor to A54 and execute:

/S#S "filename 1"<RET> F106<RET>R

in order to save the results for further processing. Hard copy results of this section can be printed using the /P command with corner parameters of A54 and F106 to obtain data grouped by industry sectors, and corner parameters A121 and F164 to print the data grouped by region.

To save input data for this module as just described, move the cursor to A12 and type:

/S#S "filename 2"<RET>E40<RET>R

2. Solving the First Share Module (SMOD.A)

Clear the screen if needed, by typing /CY and then execute

/SL SMOD.A

to load Share Module A. Scoll downward to A12 and enter the data on region condition scores by industry in the appropriate cells. As in the previous case, the input data may be saved separately by moving to A12 and typing

/S#S "filename 3" <RET>E87<RET>R

or the data may be saved within SMOD.A itself by executing

/SS SMOD.A <RET>Y

This module can be solved once the input data have been fully entered. Now save the results (reginal scores) by moving to B108 and executing

/S#S "filename 4" <RET>F167<RET>R

To obtain a hard copy of the input data, print the rectangle with corner parameters A12 and E87, and regional scores can be printed using corner parameters A104 and F167.

3. Solving the Second Share Module (SMOD.B)

After clearing (/CY), load the second share module with the command

/SL SMOD.B

Move the cursor to A11, and then execute:

/S#L "filename 4" <RET>R

The module should now be solved. Results must be saved for use in the Summary Module by moving the cursor to A145 and executing:

/S#S "filename 5" <RET>F199<RET>R

Hard copy of the share values can be obtained by using the /P command with corner parameters of A78 and F136 to show results grouped by industry, and corner parameters A145 and F199 to obtain the same data grouped by region.

4. Solving the Summary Land Module (SUMMOD)

Clear the screen once more, and load the summary module by typing

/SL SUMMOD

Next read in the results of the Share Module by moving to All and executing:

/S#L "filename 5" <RET>R

Then move the cursor to Hll to load results of the Density Module by executing:

/S#L "filename 1" <RET>R

At C75 enter industry output projections, and in the section commencing at C171 insert estimated growth in land requirements by region for the "residual industries".

Once you are satisfied with the values input for industry growth rates and for land demand growth rates for the residual industries, the module should be solved.

Hard copy results can be produced for regional shares of output, density ratios, total B.C. industry output, industry output by region, land requirements by region for the seven sectors modelled on a density and share basis, and for land requirements for the residual industries. Examples of the table formats and the corner parameters for each are given in Appendix VI.

Once this module has been solved, you may wish to produce more

consolidated reports on land requirements for each of the Lower Mainland regions. If so, move the cursor to H90 and execute:

/S#L "filename 6" <RET>M191<RET>R

This saves the information on land requirements to be subsequently input into the Report Module.

5. Solving the Report Module (REPMOD)

Clear your screen, and enter the results from the Summary Module by putting the cursor at A5 and executing:

/S#L "filename 6" <RET>

This requires no inputs from the user, and once the file has been loaded, the module should be solved.

Reports can then be generated which consolidate all land requirements for each region, rates of growth for land within each region, and the percentage shares of total regional land accounted for by each industry sector. Again, examples of the reports and the corner parameters for each are contained in Appendix VI.

This discussion serves as an introduction to ways in which the forecasting model can be manipulated. It provides sufficient information to allow for model use by any individual who is fairly well acquainted with the modelling methodology which has been employed in this study, and with Visicalc. It is advised, however, that prior to developing extensive alternatives, the prospective user should have some further discussion with the model builders.

CURRIE, COOPERS & LYBRAND

Howard G. Harowitz

HGH/nh

APPENDIX I

PROJECT ONE DATA
(IN HECTARES)

SECTOR NAME	NO.	STUDY CATEGORY	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CREAM
Food & Beverage	03	Food & Bev.		56.0	5.8	21.3
Textile & Clothing	04	Other Manufac.		1.3	0.1	N/R
Wood & Paper	05	Forest Prod.		65.2	107.6	55.4
Printing & Publishing	06	Other Manuf.		1.6	0.1	.4
Primary Fab. Metal	07	Metal Fabr.		29.7	3.7	5.7
Machinery and Elec.	08	Other Manuf.		5.4	1.3	.1
Transport Equip.	09	Other Manuf.		2.3	7.7	6.5
Non-Metallic Mineral	10	Non Met. Minerals		34.9	10.4	27.0
Chemical & Petroleum	11	Chemicals		22.0	1.4	53.6
Other Manufac.	12	Other Manuf.		.5	0.9	1.5
Unknown Manufac.	13	Other Manuf.		13.5	N/R	0
Construction Equip. & Materials Storage	14	Other Transport. & Storage		79.6	1.7	25.6
Airport	15	Major Transport.		568.0	0.1	132.8
Railway Right of Way	16	Major Transport.		N/R	N/R	9.9
Railway	17	Major Transport.		56.0	N/R	53.3
Pier	18	Major Transport.		N/R	N/R	N/R
Other Transportation	19	Other Transport. & Storage		0.0	1.7	0.0
Trucking Uses	20	Other Transport & Storage		32.3	1.5	17.9
Storage	21	Other Transport & Storage		15.2	4.4	110.8
Communications	22	Communication & Utilities		1.6	0.3	.3
Utilities	23	Communication & Utilities		9.7	0.6	13.7
Wholesaling and Warehousing	24	Wholesale Trade		102.7	5.8	14.7
				1097.0	155.1	550.5
Extractive	02			5.4	350.6	138.4

N/R = Not Reported

Sources: Dewdney - Alouette - Letter from Norman Cook to D. Walton, dated September 2, 1982 - Table 3.

Fraser Cheam - Hand-written sheets, delivered October 19, 1982, revised by phone October 25, 1982.

Central Fraser - Supply of Industrial Land and Industrial Land Use Inventory, September, 1982, Table 19.

Notes: Fraser Cheam's chemical includes one large explosives plant that has large area buffer.

Dewdney Alouette's airport number does not include Pit Meadows.

Central Fraser's numbers exclude "industrial malls" which were reqported to cover mixed uses (15.0 ha.). Dewdney Alouette has allocated mixed use occupants to appropriate SIC category.

Central Fraser's numbers for extractive have been adjusted by the R.D. since August to exclude gravel pits.

INDUSTRIAL LAND IN THE LOWER MAINLAND AS USED IN THIS STUDY (IN ACRES)

	GVRD		C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM
	1976	1981	1982	1982	1982
Forest Prod.	1875	1943	161	266	137
Metal Fabr.	1204	1210	73	9	14
Chemical	1946	1912	54	4	132
Non Met Min.	532	522	86	26	67
Food & Bev.	571	649	138	14	53
Misc Manuf.	833	972	61	25	21
Wholesale Trade	1881	2502	254	14	36
Major Transportation	9139	9214	1541	0	484
Other Transportation	1746	1876	314	23	381
Utilities & Communications	3004	3104	28	2	35
Total Secondary Industry	22731	23904	2710	383	1360

APPENDIX II

A PARTIAL BIBLIOGRAPHY ON

DECISION THEORY WITH MULTIPLE ATTRIBUTES

1. Keeney, R.L. "A Decision Analysis With Multiple Objectives: The Mexicr City Airport", Bell Journal of Economics, Vol 4 (1973), pp. 101-117.

2. _____"A Utility Function for Examining Policy Affecting Salmon in the Skiena River", RM-76-5 IIASA, 1976.

3. _____"Utility Functions for Multiattributed Consequences," Management Science, Vol. 18, No. 5 (January 1972), pp. 276-287.

4. Keeney, R.L. and Raiffa, H. Decisions with Multiple Objectives, John Wiley, New York, 1976.

5. Raiffa, H. Decision Analysis: Introductory Lectures on Choices under Uncertainty. Reading, Mass: Addison-Wesley, 1968.

6. _____"Preferences for Multi-Attributed Alternatives." RM-5868-DOT/RC, the Rand Corporation, April 1969.

7. Schlaifer, R.O. Analysis of Decision under Uncertainty. New York: McGraw-Hill, 1969.

8. von Neumann, John and Morgenstern, O. Theory of Games and Economic Behavior. Second ed. Princeton: Princeton Univ. Press, 1947.

Appendix III

QUESTIONNAIRE
LOWER MAINLAND LAND DEMAND STUDY

DATE: _____

COMPANY NAME: _____

CONTACT: _____ TEL: _____
(Interviewee)

TITLE: _____

ADDRESS (HEAD OFFICE): _____

DATE ESTABLISHED: _____

MAJOR PRODUCT LINES	SIC	PRODUCTION SITE LOCATIONS	MAJOR MARKETS

SECTION ONE

This section is designed to identify how your firm makes its decisions as to how much land to utilize in producing a given level of output. It begins with questions designed to determine your current land use in sites located in British Columbia. It then contains questions about how that land use may change in the future. Specifically:

A. Prospective changes in the productivity of land (output per land unit) that are now taking place in your industry or are expected. These most likely will result from technological innovation or the substitution of machines for labour.

B. The capacity of your existing land to accommodate a potential growth in output. Can you add to productive capacity without added land purchase by use of added production shifts or vacant land?

C. The implications of gross-up factors (zoning, parking, access, storage) necessary for additional land use.

D. The sensitivity to land cost of the amount of land you purchase to achieve a given output level.

E. Other factors that you feel will change the way in which you will utilize your present land or any newly acquired parcels.

QUESTIONS (1) - (10) DEAL WITH FACTORS THAT INFLUENCE LAND DEMAND

1. Could you provide the following information for each industrial site you own in B.C. (exclusive of sites for resource extraction)?

INVENTORY OF INDUSTRIAL SITES

B.C. Location	Nature of Operation (warehouse, manuf. and major product lines)	# of Employees at this site	Value of Shipment (output) in $	Size of Land Parcel	Year Land Purchased	Year Developed

2. For each site noted above, please break out approximate percentages or actual land quantities, as to type of usage.

BREAKDOWN OF LAND USAGE

(BY PERCENTAGE)

B.C. Location	Production*	Warehousing/ Storage	Access and Parking	Admin./ Office	Railspur/ Loading	Unused			OTHER (specify)		
						Land Banking	Buffer	Unusable			

* Where "production" is not relevant, substitute "main activities" e.g. transmission for a utility.

3. When you last expanded the output capacity of your operation, did you purchase additional land to do so? If so, how did you determine how much additional land you needed? If not, when you first established your operation, how was the desired land quantity determined?

4. If you were expanding output today by the same amount as you last expanded or first established operations, would you require the same amount of land? In more general terms, are you able to get greater output per land unit over time? Why? Will this trend continue?

3. If you required the same amount of land as you did at the time of your last expansion would you purchase the same quantity at today's prices? What kind of percentage increase in the cost of land relative to the price of the parcel you occupy today would make you do one of the following if you were to consider acquiring more for expansion:

- Buy less for inventory
- Redesign your facility to utilize less
- Relocate
- Abandon expansion plans

6. If you doubled real output would you need to purchase additional land? If the answer is no, why not?

7. If you were to build a facility on a 10 acres site, how much of such a parcel would be for non-productive use? i.e.:

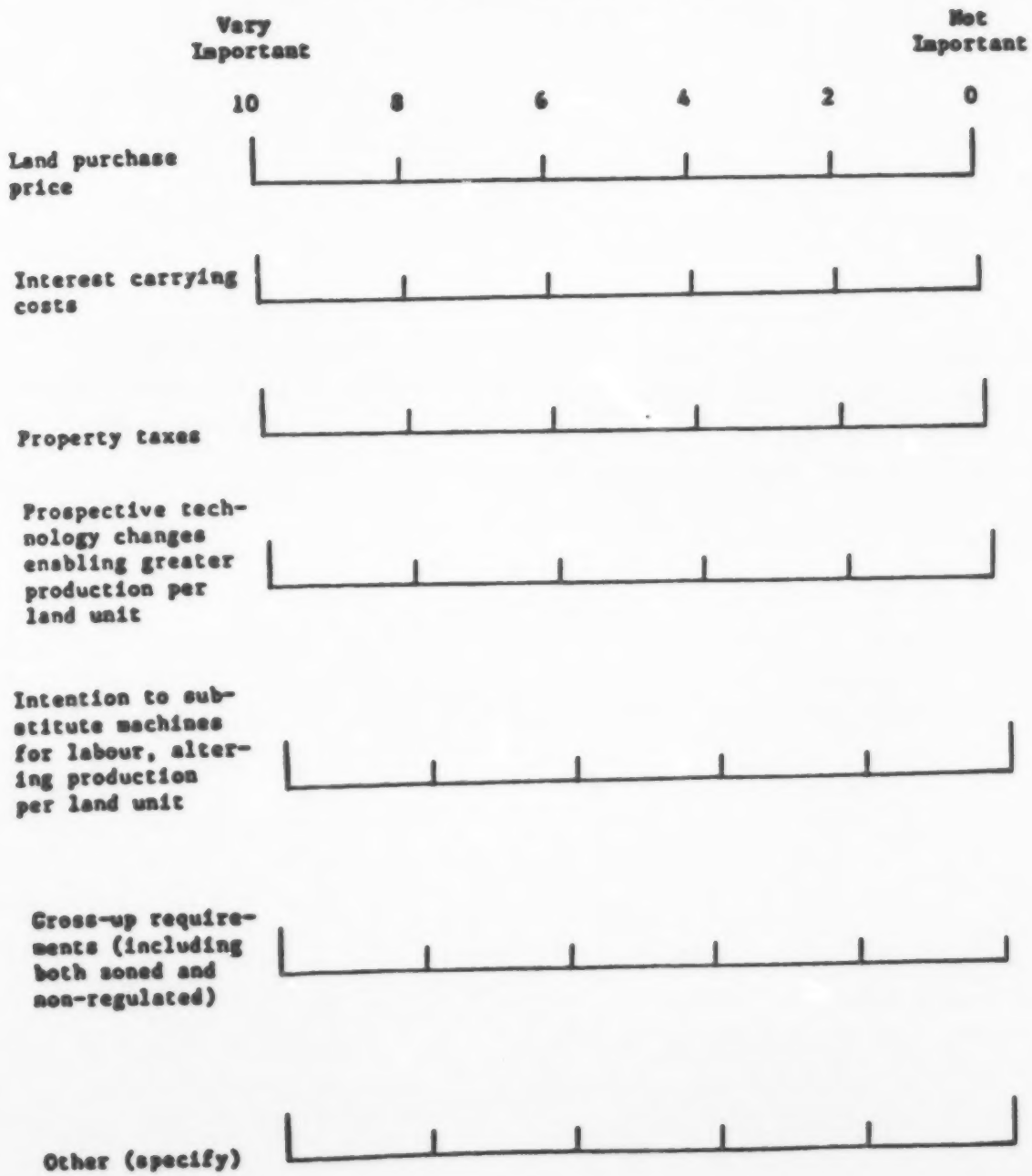
   - for indirect requirements (parking, etc.)?

   - for zoning requirements (setbacks, buffer, etc.)?

8. What factors are critical determinants as to how much land you will consume in the future?

9. Would you mark the relative importance of each factor as to how it affects your decision as to <u>how much</u> land to purchase were you to need more land for expansion?

RELATIVE IMPORTANCE OF FACTORS ON DECISIONS REGARDING THE AMOUNT OF LAND REQUIRED



SECTION TWO

This section is aimed at establishing the factors you consider as to where you choose to locate. In addition to identifying those factors (e.g. relative land costs, distance from markets) in an abstract sense, it will also ask you to compare each regional district in the Lower Mainland with respect to these factors.

10. For your plant(s) at_____

_____

_____

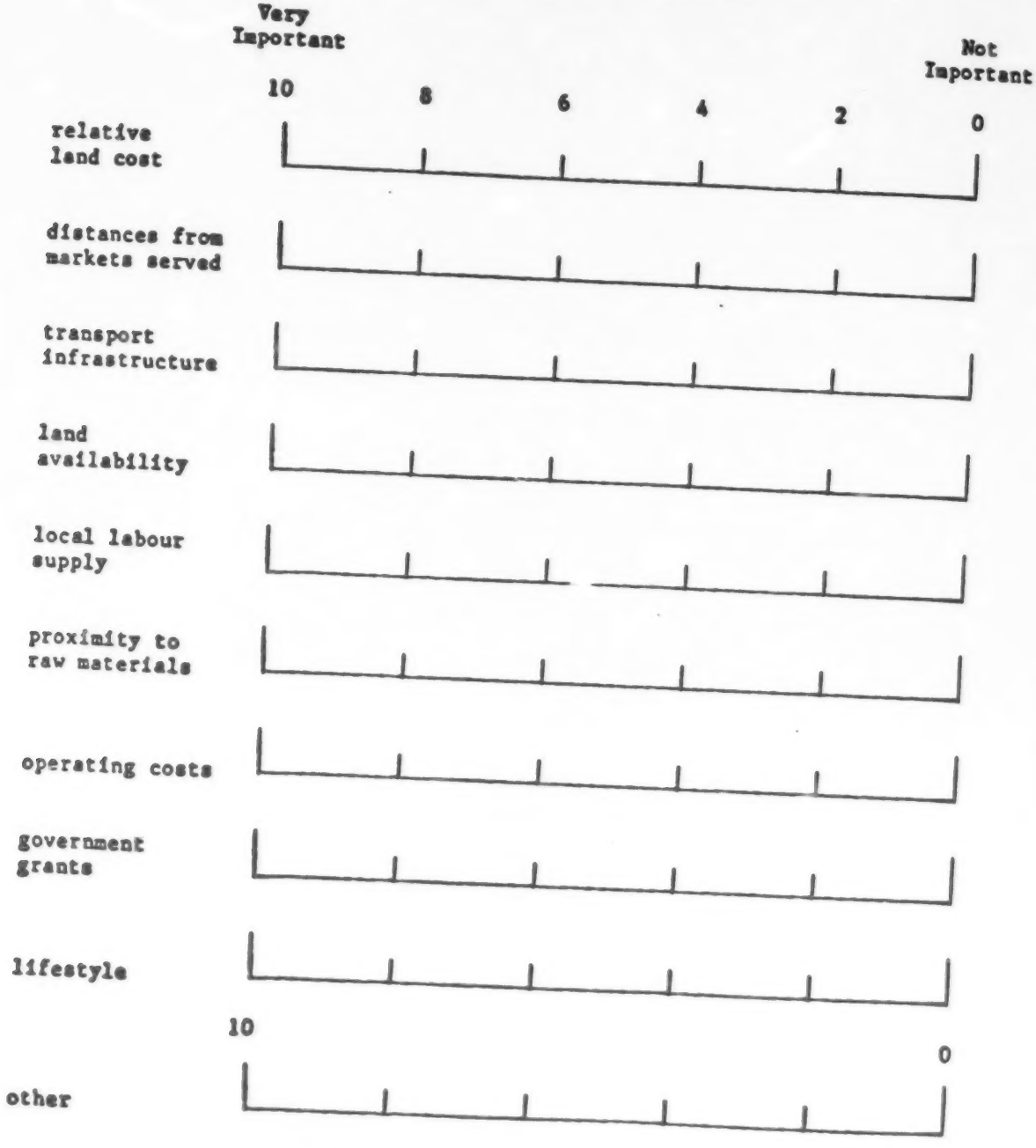
(specify different sites if applicable), why has your firm chosen to locate it (them) where it (they) is (are)?

11. To what extent (how?) do each of the following factors affect your regional location decision?

- relative land cost
- distance from markets
- transportation infrastructure
- land availability
- local labour supply
- proximity to raw materials
- operating costs (taxes, pollution control, etc.)
- government grants
- lifestyle amenities
- others (specify)

12. Rank the relative importance of each on your location decision (on chart).

RELATIVE IMPORTANCE OF
FACTORS ON LOCATION DECISIONS



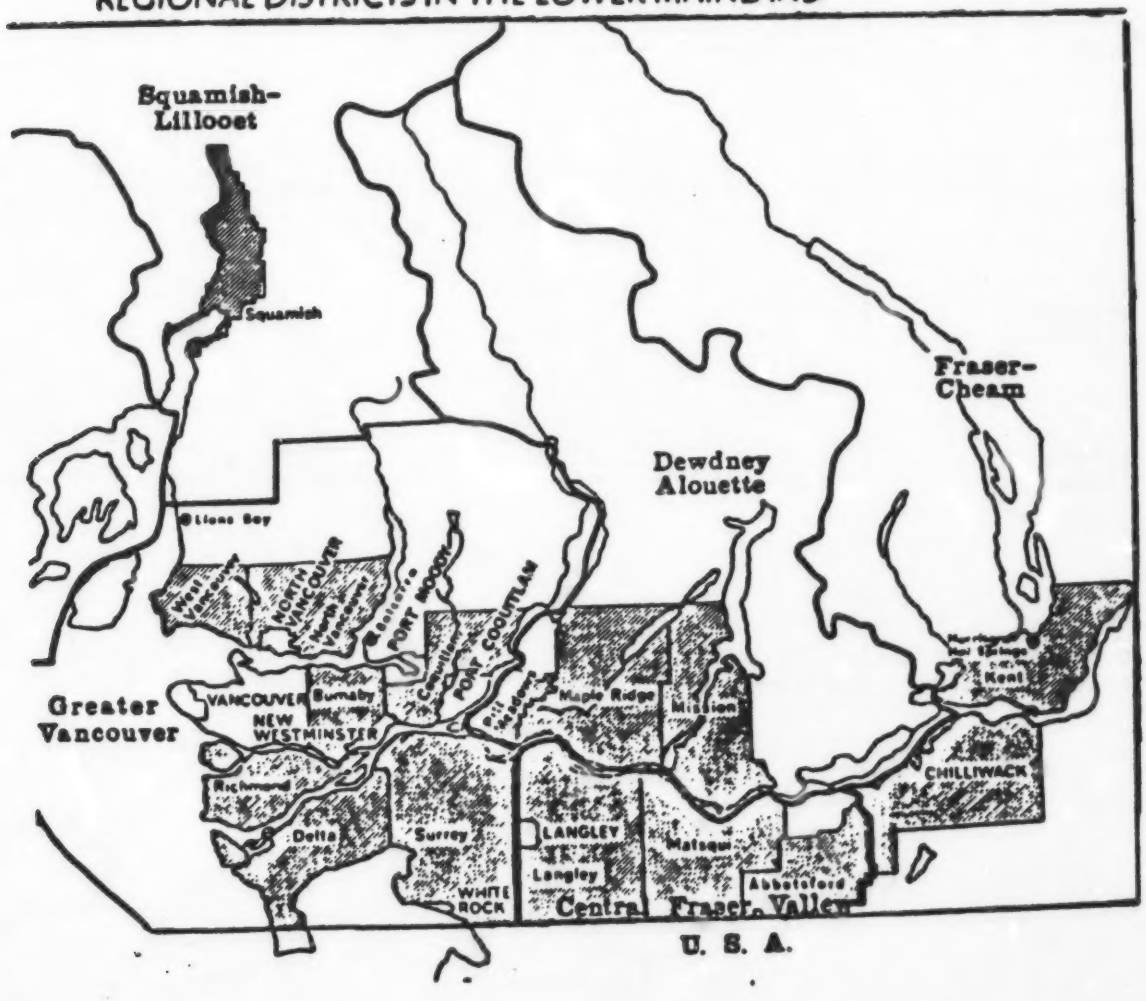
13. a) Which other regions could you conceive of as being acceptable locations? Under what conditions?

b) What would be your second choice location?

c) Are any regions totally unacceptable? Why?

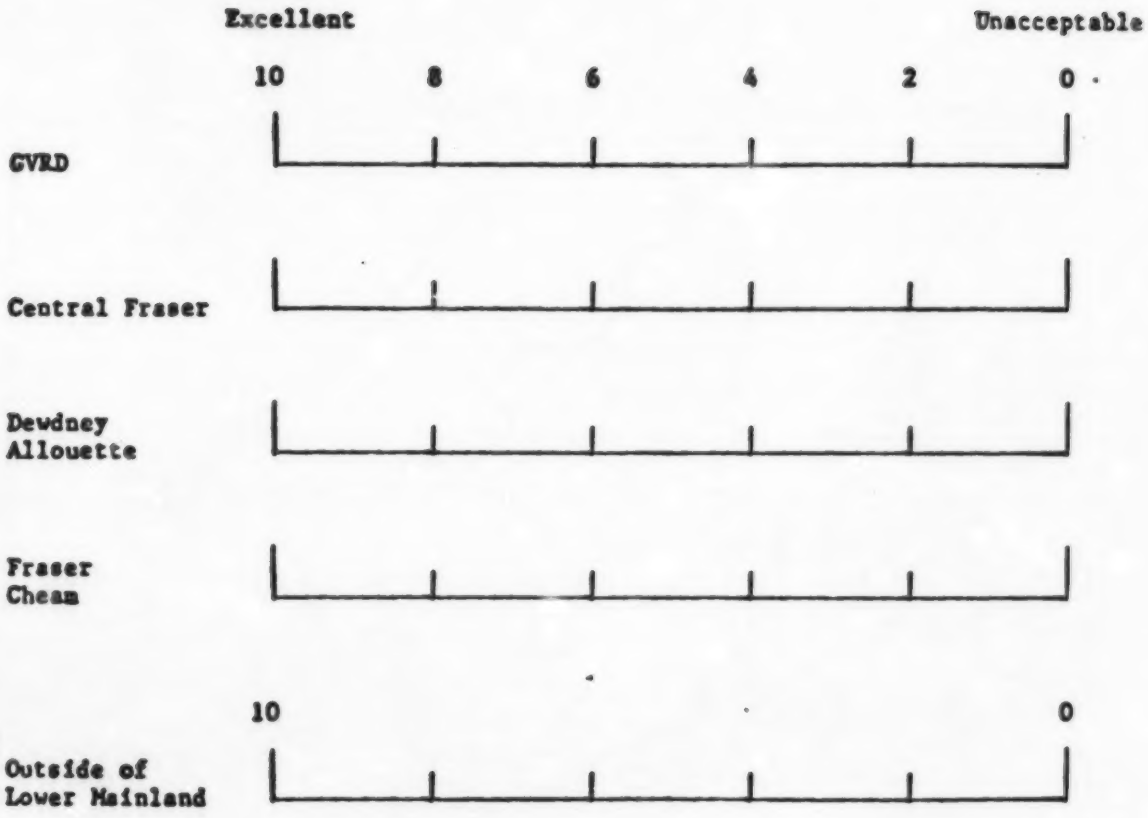
14. Please rate each region in terms of their overall attractiveness on the following chart (next page).

REGIONAL DISTRICTS IN THE LOWER MAINLAND

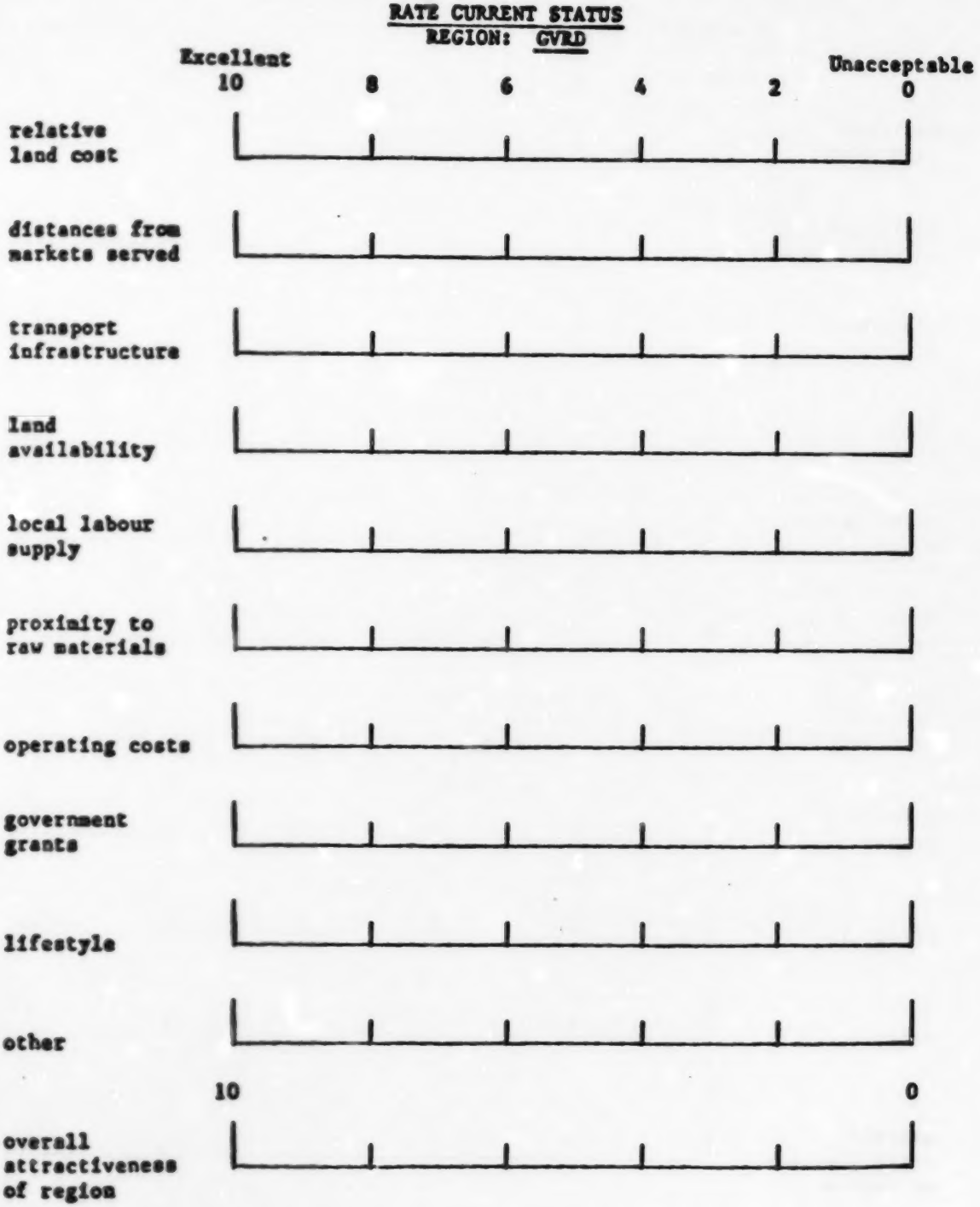


14.

RATE EACH OF THE 5 B.C.
REGIONS FOR SITE PREFERENCE
GIVEN EXISTING CONDITIONS

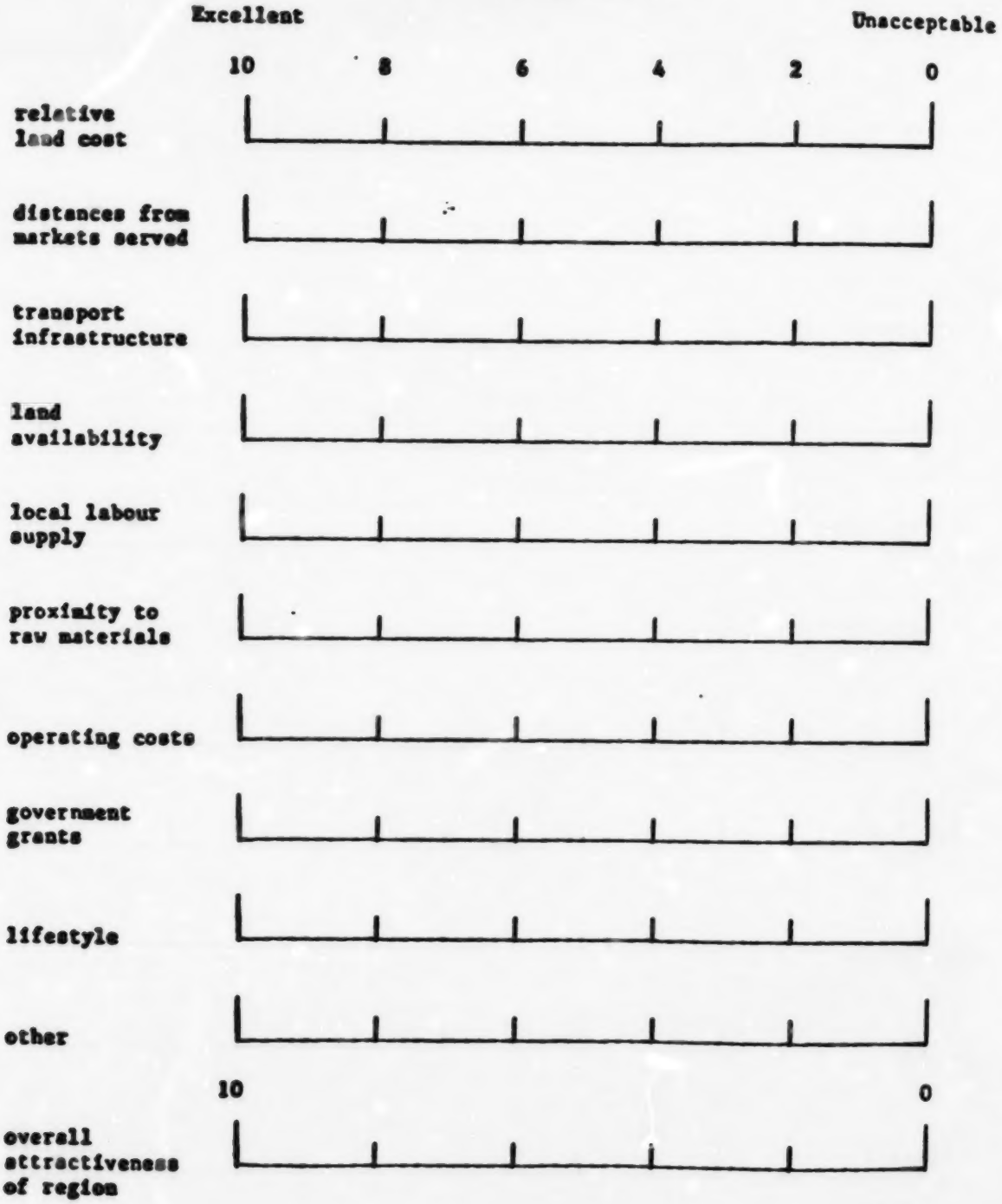


15. Rate the factors for each of the five regions (one by one) in terms of their current conditions (on chart). Rate also the overall attractiveness of the regions.



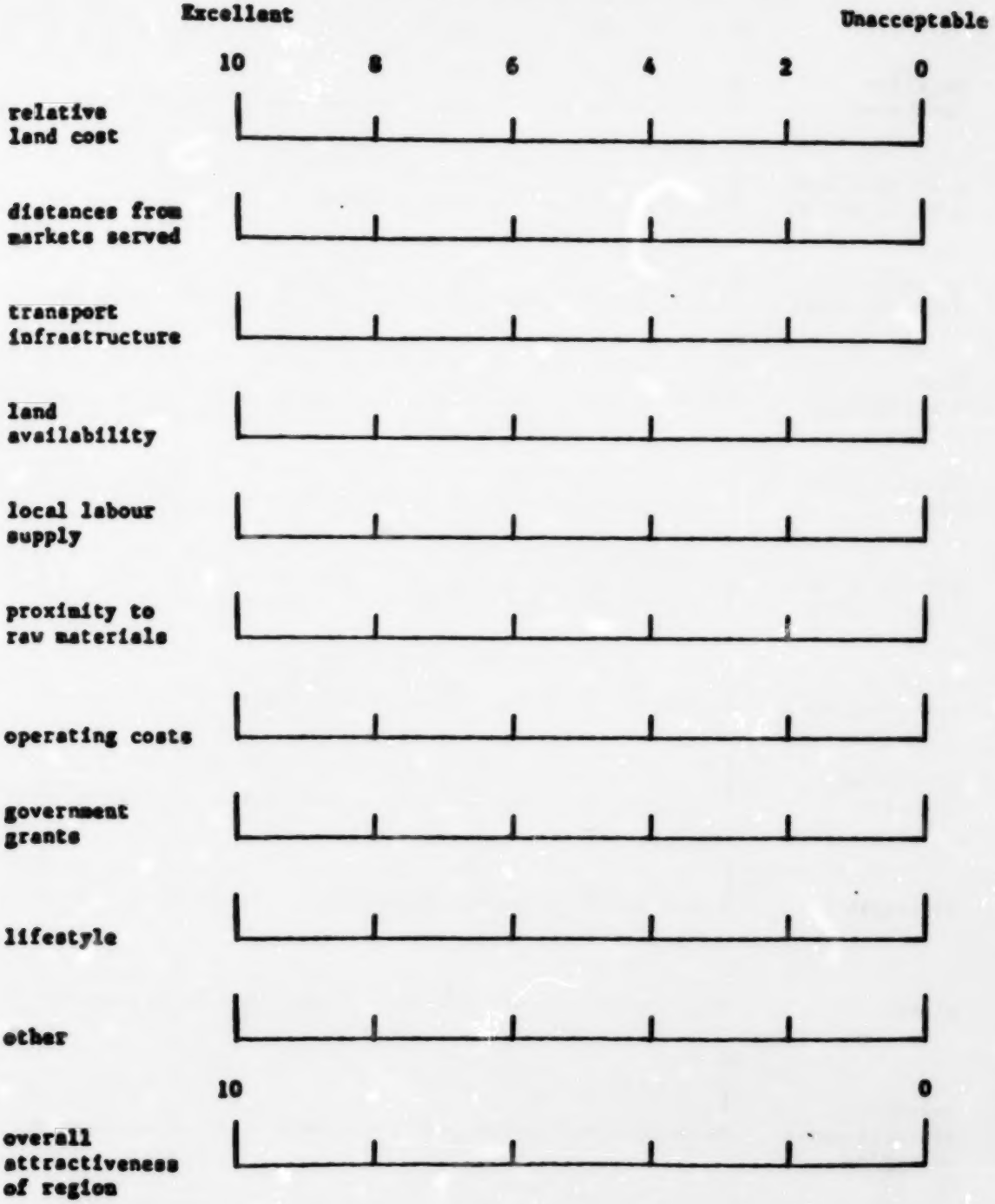
15. (cont'd.)

RATE CURRENT STATUS
REGION: CENTRAL FRASER



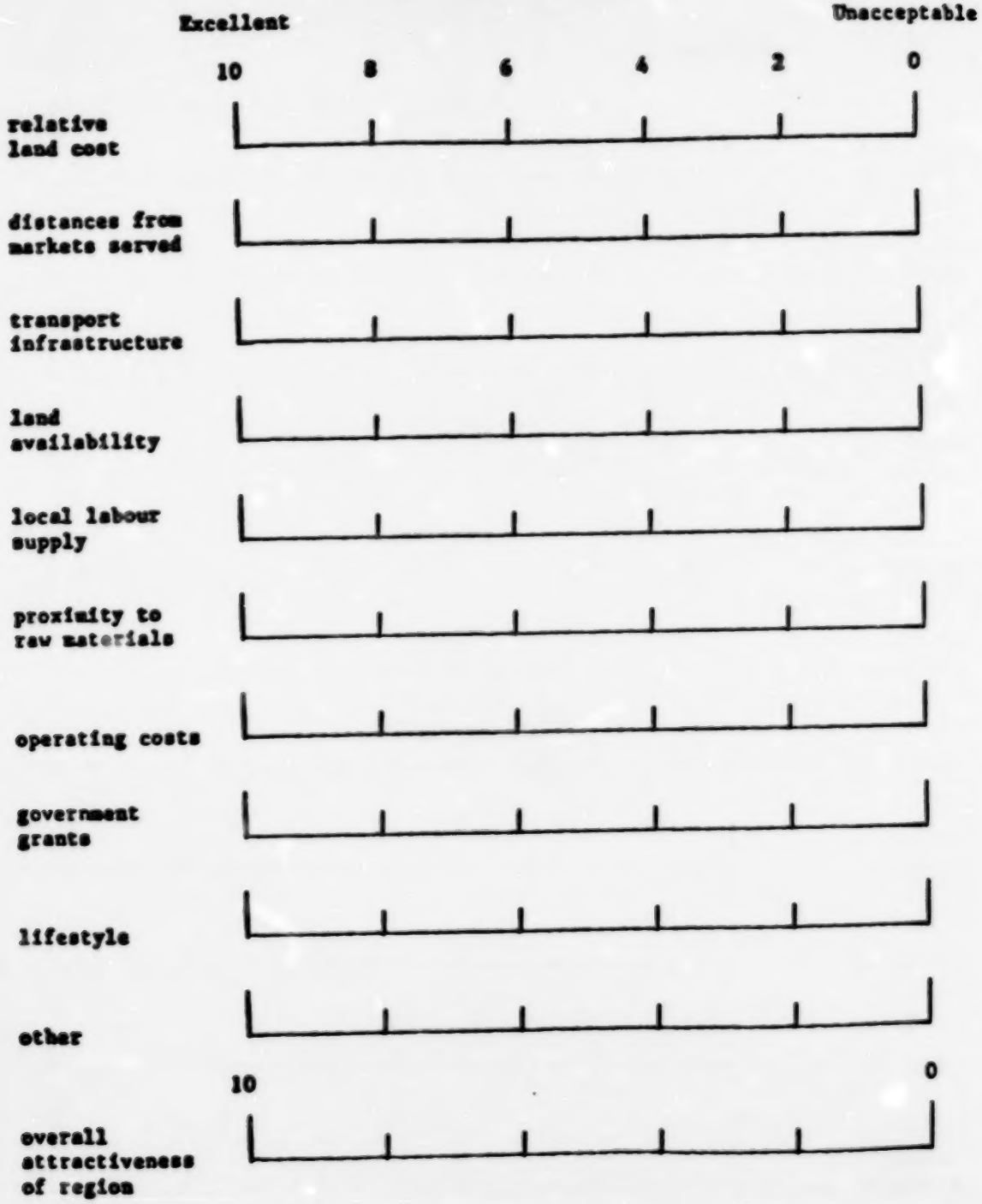
15. (cont'd.)

RATE CURRENT STATUS
REGION: DEWDNEY ALOUETTE



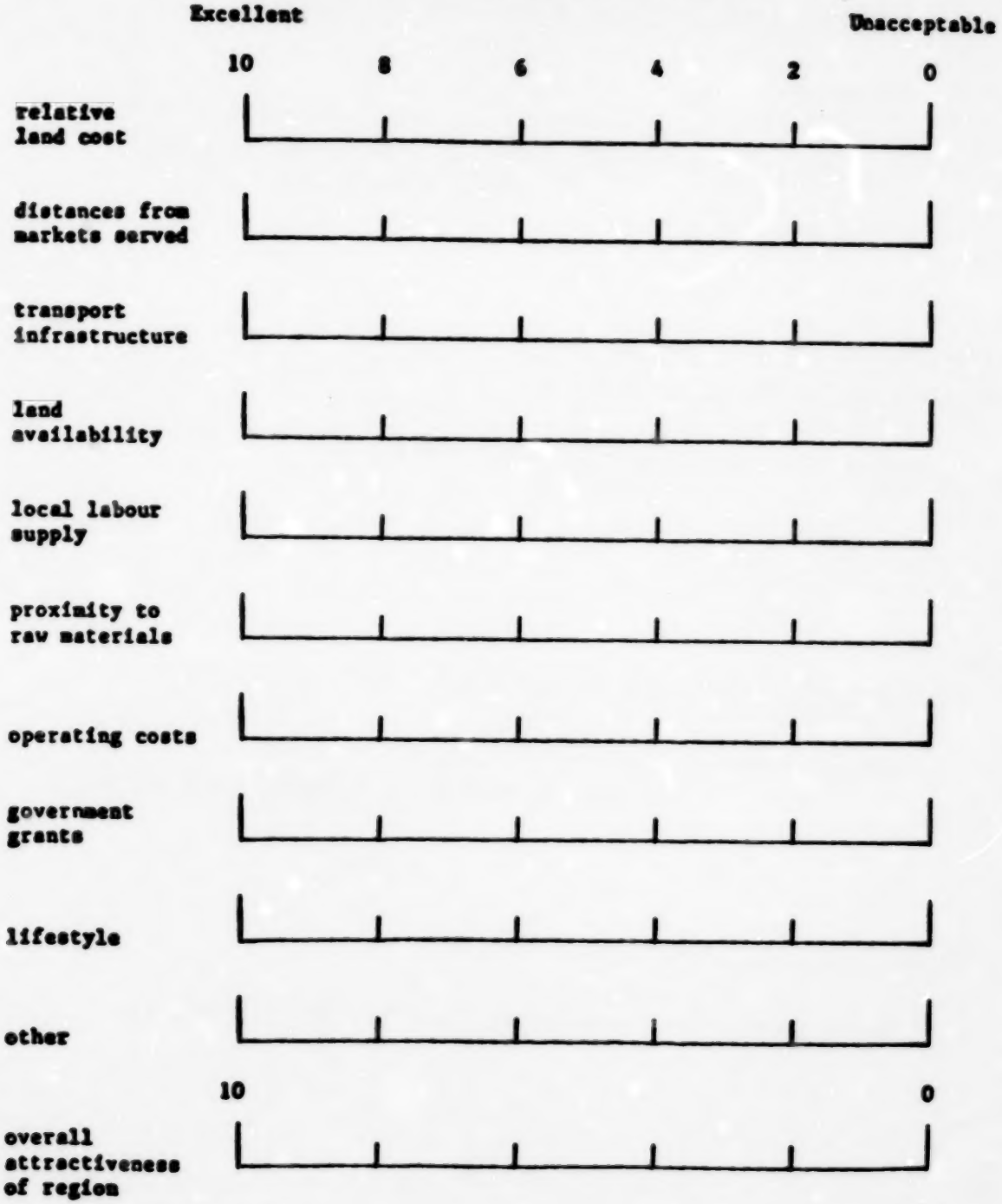
15. (cont'd.)

RATE CURRENT STATUS
REGION: FRASER CHEAM



15. (cont'd.)

RATE CURRENT STATUS
REGION: OUTSIDE OF LOWER MAINLAND



Appendix IV

MATHEMATICAL DESCRIPTION OF THE OUTPUT SHARE SUB-MODULE

Output Share is first calculated on an unconstrained basis:

$$\Delta\text{Output Share}_{i,j,t} = a_{i,j} * (\text{Average Regional Score}_{i,1981} / \text{Average Regional Score}_{i,t}) + |a_{i,j}| * 2 * \frac{(\text{Region Score}_{i,j,t} - \text{Region Score}_{i,j,1981})}{\text{Region Score}_{i,j,1982}}$$

Next, results are adjusted such that $\sum_{j=1}^{F} \Delta\text{Output Share}_{i,j,t} = 0$. This requires two intermediate calculations:

$$\text{Unconstrained Change}_{i,t} = \sum_{j=1}^{F} \Delta\text{Output Share}_{i,j,t}$$

$$\text{Prorata Weight}_{i,j,t} = |\Delta\text{Output Share}_{i,j,t}| / \sum_{j=1}^{F} |\Delta\text{Output Share}_{i,j,t}|$$

Given these calculations, the adjusted ΔOutput Share can be calculated:

$$\Delta\text{Output Share}_{i,j,t} = \Delta\text{Output Share}_{i,j,t} - \text{Prorata Weight}_{i,j,t} * \text{Unconstrained Change}_{i,t}$$

Finally Total Output Shares are calculated:

$$\text{Output Share}_{i,j,t} = \text{Output Share}_{i,j,t-1} + \Delta\text{Output Share}_{i,j,t}$$

ENDOGENOUS & EXOGENOUS VARIABLES

DENSITY MODULE

EXOGENOUS VARIABLES	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.	B.C. TOTAL
User Supplied Values						
Factor Condition Index (1986,1991,1996,2001)						
Land Costs	x	x	x	x		
Interest Rates	x	x	x	x		
Tax Rates						x
Technology Change						x
Capital/Labour Ratios						x
Gross-ups						x
Model Supplied Values						
1981 Density Levels						
Forest Prod.	x	x	x	x		
Metal Fabrication	x			x		
Chemicals	x	x	x	x		
Food & Beverages	x	x	x	x		
Non-Metallic Minerals	x	x	x	x		
Other Manufacturing	x	x	x	x		
Wholesale Trade	x	x	x	x		
Base Level Density Change						
Forest Prod.	x	x	x	x		
Metal Fabrication	x	x	x	x		
Chemicals	x	x	x	x		
Food & Beverages	x	x	x	x		
Non-Metallic Minerals	x	x	x	x		
Other Manufacturing	x	x	x	x		
Wholesale Trade	x	x	x	x		

ENDOGENOUS & EXOGENOUS VARIABLES

DENSITY MODULE

ENDOGENOUS VARIABLES	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.	B.C. TOTAL
Density Levels (1986,1991,1996,2001)						
Forest Prod.	x	x	x	x		
Metal Fabrication	x	x	x	x		
Chemicals	x	x	x	x		
Food & Beverages	x	x	x	x		
Non-Metallic Minerals	x	x	x	x		
Other Manufacturing	x	x	x	x		
Wholesale Trade	x	x	x	x		

ENDOGENOUS & EXOGENOUS VARIABLES

SHARE MODULE

EXOGENOUS VARIABLES	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.	B.C. TOTAL
User Supplied Values						
Factor Condition Index (1986,1991,1996,2001)						
Land Costs	x	x	x	x	x	
Distance From Markets	x	x	x	x	x	
Transportation	x	x	x	x	x	
Land Availability	x	x	x	x	x	
Labour Supply	x	x	x	x	x	
Proximity to Raw Mat.	x	x	x	x	x	
Operating Costs	x	x	x	x	x	
Government Grants	x	x	x	x	x	
Lifestyle	x	x	x	x	x	
Model Supplied Values						
1981 Region Scores						
Forest Prod.	x	x	x	x	x	
Metal Fabrication	x	x	x	x	x	
Chemicals	x	x	x	x	x	
Food & Beverages	x	x	x	x	x	
Non-Metallic Minerals	x	x	x	x	x	
Other Manufacturing	x	x	x	x	x	
Wholesale Trade	x	x	x	x	x	
1981 Region Shares						
Forest Prod.	x	x	x	x	x	
Metal Fabrication	x	x	x	x	x	
Chemicals	x	x	x	x	x	
Food & Beverages	x	x	x	x	x	
Non-Metallic Minerals	x	x	x	x	x	
Other Manufacturing	x	x	x	x	x	
Wholesale Trade	x	x	x	x	x	
Base Level Share Change						
Forest Prod.	x	x	x	x	x	
Metal Fabrication	x	x	x	x	x	
Chemicals	x	x	x	x	x	
Food & Beverages	x	x	x	x	x	
Non-Metallic Minerals	x	x	x	x	x	
Other Manufacturing	x	x	x	x	x	
Wholesale Trade	x	x	x	x	x	

ENDOGENOUS & EXOGENOUS VARIABLES

SHARE MODULE

ENDOGENOUS VARIABLES	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.	B.C. TOTAL
Region Scores (1986,1991,1996,2001)						
Forest Prod.	x	x	x	x	x	x
Metal Fabrication	x	x	x	x	x	x
Chemicals	x	x	x	x	x	x
Food & Beverages	x	x	x	x	x	x
Non-Metallic Minerals	x	x	x	x	x	x
Other Manufacturing	x	x	x	x	x	x
Wholesale Trade	x	x	x	x	x	x
Regional Output Shares 1986,1991,1996,2001						
Forest Prod.	x	x	x	x	x	
Metal Fabrication	x	x	x	x	x	
Chemicals	x	x	x	x	x	
Food & Beverages	x	x	x	x	x	
Non-Metallic Minerals	x	x	x	x	x	
Other Manufacturing	x	x	x	x	x	
Wholesale Trade	x	x	x	x	x	

ENDOGENOUS & EXOGENOUS VARIABLES

LAND/OUTPUT MODULE

EXOGENOUS VARIABLES	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.	B.C. TOTAL
User Supplied Values						
Growth In Output 1986,1991,1996,2001						
Forest Prod.						x
Metal Fabrication						x
Chemicals						x
Food & Beverages						x
Non-Metallic Minerals						x
Other Manufacturing						x
Wholesale Trade						x
Growth in Land Demand (1986,1991,1996,2001)						
Major Transportation	x	x	x	x		
Other Transportation	x	x	x	x		
Utilities	x	x	x	x		
Model Supplied Values						
1981 Output Levels						
Forest Prod.	x	x	x	x	x	x
Metal Fabrication	x	x	x	x	x	x
Chemicals	x	x	x	x	x	x
Food & Beverages	x	x	x	x	x	x
Non-Metallic Minerals	x	x	x	x	x	x
Other Manufacturing	x	x	x	x	x	x
Wholesale Trade	x	x	x	x	x	x
1981 Land Required						
Forest Prod.	x	x	x	x		
Metal Fabrication	x	x	x	x		
Chemicals	x	x	x	x		
Food & Beverages	x	x	x	x		
Non-Metallic Minerals	x	x	x	x		
Other Manufacturing	x	x	x	x		
Wholesale Trade	x	x	x	x		
Major Transportation	x	x	x	x		
Other Transportation	x	x	x	x		
Utilities	x	x	x	x		

ENDOGENOUS & EXOGENOUS VARIABLES

LAND/OUTPUT MODULE

ENDOGENOUS VARIABLES	GVRD	C FRASER VALLEY	DEWDNEY ALOUETTE	FRASER CHEAM	REST OF B.C.	B.C. TOTAL
Total Output (1986,1991,1996,2001)						
Forest Prod.	x	x	x	x	x	x
Metal Fabrication	x	x	x	x	x	x
Chemicals	x	x	x	x	x	x
Food & Beverages	x	x	x	x	x	x
Non-Metallic Minerals	x	x	x	x	x	x
Other Manufacturing	x	x	x	x	x	x
Wholesale Trade	x	x	x	x	x	x
Land Required (1986,1991,1996,2001)						
Forest Prod.	x	x	x	x		
Metal Fabrication	x	x	x	x		
Chemicals	x	x	x	x		
Food & Beverages	x	x	x	x		
Non-Metallic Minerals	x	x	x	x		
Other Manufacturing	x	x	x	x		
Wholesale Trade	x	x	x	x		
Major Transportation	x	x	x	x		
Other Transportation	x	x	x	x		
Utilities	x	x	x	x		

CORNER PARAMETERS

DENSITY MODULE
(DMOD)

A12

Region Factors

E40

A54

Density Ratios
By Industry

F106

A121

Density Ratios
By Region

F164

DENSITY MODULE

DATA SECTION

COMMON DENSITY FACTORS:

	INDEX VALUES 1981-86	1986-91	1991-96	1996-2001
INT. COST	1.30	1.30	1.30	1.30
TECH. CHANGE	0.95	0.95	0.95	0.95
CAP. SUBST'N	0.95	0.95	1.00	1.00
GROSS UP	1.00	1.00	1.00	1.00

REGION-SPECIFIC DENSITY FACTORS:

LAND PRICE				
GVRD	1.15	1.10	1.05	1.05
C FRASER VAL	1.15	1.00	0.95	0.95
DEWDNEY AL.	1.15	1.00	0.95	0.95
FRASER CHEAM	1.15	1.00	0.95	0.95
PROPERTY TAX				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00

DENSITY RATIOS

	1981	1986	1991	1996	2001
FOREST PROD.					
GVRD	0.68	0.68	0.69	0.71	0.72
C FRASER VAL	0.29	0.29	0.30	0.32	0.33
DEWDNEY AL.	0.78	0.78	0.73	0.77	0.80
FRASER CHEAM	0.68	0.68	0.62	0.66	0.69
METAL FABR.					
GVRD	0.98	0.95	1.01	1.08	1.16
C FRASER VAL	0.95	1.00	1.09	1.19	1.31
DEWDNEY AL.	1.00	1.05	1.14	1.26	1.38
FRASER CHEAM	1.00	1.05	1.14	1.26	1.38
CHEMICAL					
GVRD	0.95	0.99	1.03	1.09	1.15
C FRASER VAL	1.00	1.04	1.11	1.18	1.28
DEWDNEY AL.	1.00	1.04	1.11	1.18	1.28
FRASER CHEAM	0.03	0.03	0.03	0.04	0.04
NON MET MIN.					
GVRD	0.48	0.54	0.62	0.72	0.84
C FRASER VAL	0.10	0.11	0.13	0.16	0.19
DEWDNEY AL.	0.12	0.14	0.16	0.19	0.22
FRASER CHEAM	0.10	0.11	0.13	0.16	0.19
FOOD & BEV.					
GVRD	2.62	2.81	3.04	3.32	3.53
C FRASER VAL	1.30	1.39	1.54	1.71	1.87
DEWDNEY AL.	2.21	2.37	2.61	2.91	3.18
FRASER CHEAM	2.26	2.42	2.67	2.98	3.25
MISC MANUF					
GVRD	1.64	1.66	1.78	1.76	1.83
C FRASER VAL	0.81	0.82	0.86	0.98	0.96
DEWDNEY AL.	1.36	1.38	1.44	1.51	1.61
FRASER CHEAM	1.19	1.21	1.26	1.32	1.41
WHOLSL TRADE					
GVRD	4.13	4.31	4.55	4.91	5.29
C FRASER VAL	2.02	2.11	2.28	2.50	2.75
DEWDNEY AL.	20.36	21.26	22.97	25.24	27.75
FRASER CHEAM	7.92	8.27	8.93	9.82	10.79

DENSITY RATIOS

	1981	1986	1991	1996	2001
G V R D					
FOREST PROD.	0.68	0.68	0.68	0.70	0.71
METAL FABR.	0.98	0.94	0.99	1.07	1.14
CHEMICAL	0.95	0.98	1.03	1.08	1.14
NON MET MIN.	0.48	0.54	0.62	0.71	0.83
FOOD & BEV.	2.62	2.79	2.99	3.26	3.47
MISC MANUF	1.64	1.65	1.68	1.73	1.81
WHOLSL TRADE	4.13	4.29	4.50	4.85	5.23
C FRASER VAL					
FOREST PROD.	0.29	0.29	0.30	0.31	0.33
METAL FABR.	0.95	0.99	1.07	1.18	1.29
CHEMICAL	1.00	1.04	1.10	1.18	1.27
NON MET MIN.	0.10	0.11	0.13	0.16	0.19
FOOD & BEV.	1.30	1.38	1.51	1.68	1.84
MISC MANUF	0.81	0.82	0.85	0.89	0.95
WHOLSL TRADE	2.02	2.10	2.25	2.48	2.72
DEWDNEY AL.					
FOREST PROD.	0.70	0.70	0.72	0.74	0.79
METAL FABR.	1.00	1.05	1.13	1.24	1.36
CHEMICAL	1.00	1.04	1.10	1.18	1.27
NON MET MIN.	0.12	0.14	0.16	0.19	0.22
FOOD & BEV.	2.21	2.35	2.57	2.86	3.13
MISC MANUF	1.36	1.37	1.42	1.49	1.59
WHOLSL TRADE	20.36	21.14	22.72	24.97	27.45
FRASER CHEAM					
FOREST PROD.	0.68	0.68	0.62	0.65	0.68
METAL FABR.	1.00	1.05	1.13	1.24	1.36
CHEMICAL	0.03	0.03	0.03	0.03	0.03
NON MET MIN.	0.10	0.11	0.13	0.16	0.19
FOOD & BEV.	2.26	2.40	2.63	2.93	3.20
MISC MANUF	1.19	1.20	1.24	1.31	1.39
WHOLSL TRADE	7.92	8.22	8.84	9.71	10.68

CORNER PARAMETERS

SHARE MODULE A
(SMOD.A)

A12

Region Factors

E87

A104

Region Scores

F167

INDEX VALUES FOR REGION CONDITIONS

LAND PRICE	1981-86	1986-91	1991-96	1996-2001
GVRD	1.15	1.10	1.05	1.05
C FRASER VAL	1.15	1.00	0.95	0.95
DEWDNEY AL.	1.15	1.00	0.95	0.95
FRASER CHEAM	1.15	1.00	0.95	0.95
REST OF B.C.	1.00	1.00	1.00	1.00
DIST TO MRKT				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.05	1.10
DEWDNEY AL.	1.00	1.05	1.10	1.15
FRASER CHEAM	1.00	1.05	1.10	1.15
REST OF B.C.	1.00	1.05	1.10	1.15
TRNSPORTAT'N				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.10	1.20	1.25
FRASER CHEAM	1.00	1.10	1.20	1.25
REST OF B.C.	1.00	1.10	1.10	1.10
LAND AVAIL'Y				
GVRD	1.00	0.95	0.90	0.90
C FRASER VAL	1.00	1.00	0.95	0.90
DEWDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00
LABOR SUPPLY				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.00	1.05	1.05
FRASER CHEAM	1.00	1.05	1.05	1.10
REST OF B.C.	1.00	1.05	1.05	1.10
R MAT ACCESS				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.00	1.05	1.10
FRASER CHEAM	1.00	1.00	1.05	1.10
REST OF B.C.	1.00	1.10	1.30	1.30
PROPERTY TAX				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00
GOVT GRANTS				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00
LIFESTYLE				
GVRD	1.00	1.00	1.00	1.00
C FRASER VAL	1.00	1.00	1.00	1.00
DEWDNEY AL.	1.00	1.00	1.00	1.00
FRASER CHEAM	1.00	1.00	1.00	1.00
REST OF B.C.	1.00	1.00	1.00	1.00

REGIONAL SCORES

FOREST PROD.	1981	1986	1991	1996	2001
GVRD	5.78	5.85	5.91	5.86	5.82
C FRASER VAL	5.28	5.34	5.34	5.27	5.17
DEWDNEY AL.	3.08	3.08	3.15	3.29	3.49
FRASER CHEAM	1.10	1.13	1.16	1.21	1.29
REST OF B.C.	6.38	6.58	6.74	7.16	7.67
MEAN	4.38	4.38	4.46	4.54	4.69
METAL FABR.					
GVRD	6.08	6.15	6.28	6.14	6.08
C FRASER VAL	6.58	6.67	6.67	6.58	6.45
DEWDNEY AL.	2.08	2.05	2.09	2.17	2.29
FRASER CHEAM	1.58	1.54	1.58	1.64	1.74
REST OF B.C.	4.68	4.68	4.75	5.01	5.33
MEAN	4.12	4.28	4.26	4.31	4.38
CHEMICAL					
GVRD	8.08	8.11	8.16	8.14	8.13
C FRASER VAL	2.08	2.03	2.03	2.03	2.04
DEWDNEY AL.	1.08	1.01	1.04	1.11	1.21
FRASER CHEAM	1.08	1.01	1.04	1.11	1.22
REST OF B.C.	6.08	6.08	6.31	6.93	7.71
MEAN	3.68	3.63	3.72	3.87	4.06
NON MET MIN.					
GVRD	7.08	7.13	7.16	7.09	7.03
C FRASER VAL	7.58	7.64	7.64	7.57	7.58
DEWDNEY AL.	5.08	5.09	5.21	5.28	5.93
FRASER CHEAM	4.08	4.07	4.19	4.42	4.88
REST OF B.C.	1.08	1.08	1.05	1.14	1.25
MEAN	4.98	4.98	5.05	5.15	5.38
FOOD & BEV.					
GVRD	4.38	4.38	4.41	4.39	4.37
C FRASER VAL	8.78	8.87	8.87	8.83	8.79
DEWDNEY AL.	2.38	2.34	2.39	2.58	2.67
FRASER CHEAM	3.18	3.16	3.24	3.48	3.65
REST OF B.C.	1.08	1.08	1.04	1.12	1.22
MEAN	3.88	3.95	3.99	4.05	4.14
MISC MANUF					
GVRD	8.38	8.45	8.51	8.47	8.44
C FRASER VAL	5.38	5.48	5.48	5.38	5.37
DEWDNEY AL.	2.48	2.44	2.58	2.63	2.83
FRASER CHEAM	1.08	1.02	1.05	1.11	1.28
REST OF B.C.	4.38	4.38	4.47	4.77	5.16
MEAN	4.26	4.32	4.39	4.47	4.68
WHOLSL TRADE					
GVRD	8.08	8.19	8.25	8.18	8.11
C FRASER VAL	5.08	5.12	5.12	5.07	5.02
DEWDNEY AL.	2.08	2.05	2.11	2.22	2.38
FRASER CHEAM	1.08	1.02	1.06	1.11	1.28
REST OF B.C.	5.08	5.08	5.17	5.39	5.69
MEAN	4.28	4.28	4.34	4.48	4.48

CORNER PARAMETERS

SHARE MODULE B
(SMOD.B)

A87

Region Output Shares
By Industry

F136

F145

Region Output Shares
By Region

F199

REGION'S SHARES
OF TOTAL B.C. OUTPUT

FOREST PROD.	1981	1986	1991	1996	2001
GVRD	0.19	0.18	0.17	0.16	0.15
C FRASER VAL	0.01	0.01	0.01	0.01	0.01
DEWDNEY AL.	0.03	0.03	0.03	0.04	0.04
FRASER CHEAM	0.01	0.01	0.01	0.02	0.02
REST OF B.C.	0.76	0.77	0.77	0.78	0.78
METAL FABR.					
GVRD	0.49	0.47	0.45	0.43	0.41
C FRASER VAL	0.03	0.04	0.05	0.06	0.07
DEWDNEY AL.	0.00	0.01	0.01	0.01	0.01
FRASER CHEAM	0.01	0.01	0.01	0.01	0.01
REST OF B.C.	0.47	0.48	0.48	0.49	0.49
CHEMICAL					
GVRD	0.77	0.81	0.85	0.79	0.72
C FRASER VAL	0.02	0.03	0.04	0.05	0.06
DEWDNEY AL.	0.00	0.00	0.00	0.00	0.00
FRASER CHEAM	0.00	0.00	0.00	0.00	0.00
REST OF B.C.	0.20	0.15	0.11	0.16	0.21
NON MET MIN.					
GVRD	0.58	0.61	0.65	0.69	0.72
C FRASER VAL	0.02	0.03	0.04	0.05	0.05
DEWDNEY AL.	0.01	0.01	0.01	0.01	0.01
FRASER CHEAM	0.02	0.02	0.02	0.02	0.02
REST OF B.C.	0.38	0.34	0.28	0.24	0.20
FOOD & BEV.					
GVRD	0.66	0.67	0.67	0.68	0.69
C FRASER VAL	0.07	0.08	0.09	0.10	0.10
DEWDNEY AL.	0.01	0.01	0.02	0.02	0.02
FRASER CHEAM	0.05	0.05	0.05	0.05	0.06
REST OF B.C.	0.22	0.19	0.17	0.15	0.13
MISC MANUF					
GVRD	0.89	0.87	0.84	0.82	0.79
C FRASER VAL	0.03	0.03	0.04	0.04	0.05
DEWDNEY AL.	0.02	0.02	0.03	0.04	0.04
FRASER CHEAM	0.01	0.01	0.01	0.01	0.01
REST OF B.C.	0.05	0.06	0.08	0.09	0.11
WHOLSL TRADE					
GVRD	0.54	0.55	0.53	0.52	0.50
C FRASER VAL	0.03	0.03	0.03	0.04	0.04
DEWDNEY AL.	0.02	0.02	0.02	0.02	0.02
FRASER CHEAM	0.02	0.02	0.02	0.02	0.02
REST OF B.C.	0.38	0.39	0.40	0.41	0.42

REGION'S SHARES
OF TOTAL B.C. OUTPUT

	1981	1986	1991	1996	2001
G V R D					
FOREST PROD.	0.19	0.18	0.17	0.16	0.15
METAL FABR.	0.49	0.47	0.45	0.43	0.41
CHEMICAL	0.77	0.81	0.85	0.79	0.72
NON MET MIN.	0.58	0.61	0.65	0.69	0.72
FOOD & BEV.	0.66	0.67	0.67	0.68	0.69
MISC MANUF	0.89	0.87	0.84	0.82	0.79
WHOLSL TRADE	0.56	0.55	0.53	0.52	0.50
C FRASER VAL					
FOREST PROD.	0.01	0.01	0.01	0.01	0.01
METAL FABR.	0.03	0.04	0.05	0.06	0.07
CHEMICAL	0.02	0.03	0.04	0.05	0.06
NON MET MIN.	0.02	0.03	0.04	0.05	0.05
FOOD & BEV.	0.07	0.08	0.09	0.10	0.10
MISC MANUF	0.03	0.03	0.04	0.04	0.05
WHOLSL TRADE	0.03	0.03	0.03	0.04	0.04
DEWDNEY AL.					
FOREST PROD.	0.03	0.03	0.03	0.04	0.04
METAL FABR.	0.00	0.01	0.01	0.01	0.01
CHEMICAL	0.00	0.00	0.00	0.00	0.00
NON MET MIN.	0.01	0.01	0.01	0.01	0.01
FOOD & BEV.	0.01	0.01	0.02	0.02	0.02
MISC MANUF	0.02	0.02	0.03	0.04	0.04
WHOLSL TRADE	0.02	0.02	0.02	0.02	0.02
FRASER CHEAM					
FOREST PROD.	0.01	0.01	0.01	0.02	0.02
METAL FABR.	0.01	0.01	0.01	0.01	0.01
CHEMICAL	0.00	0.00	0.00	0.00	0.00
NON MET MIN.	0.02	0.02	0.02	0.02	0.02
FOOD & BEV.	0.05	0.05	0.05	0.05	0.06
MISC MANUF	0.01	0.01	0.01	0.01	0.01
WHOLSL TRADE	0.02	0.02	0.02	0.02	0.02
OTHER B.C.					
FOREST PROD.	0.76	0.77	0.77	0.78	0.78
METAL FABR.	0.47	0.48	0.48	0.49	0.49
CHEMICAL	0.20	0.15	0.11	0.16	0.21
NON MET MIN.	0.38	0.34	0.28	0.24	0.20
FOOD & BEV.	0.22	0.19	0.17	0.15	0.13
MISC MANUF	0.05	0.06	0.08	0.09	0.11
WHOLSL TRADE	0.38	0.39	0.40	0.41	0.42

CORNER PARAMETERS

OUTPUT/LAND MODULE
(SUMMOD)

A11

Region Output Shares
By Region

F65

H11

Density Factors
By Region

H54

A69

Total
Industry Output Assumptions

F82

H69

Total
Industry Output

H82

A90

Industry Output By Region

F161

H90

Land Reqirements
By Region

H162

A165

Residual Industries
Land Growth Rates

F190

H165

Residual Industries
Requirements

H191

REGION'S SHARES
OF TOTAL B.C. OUTPUT

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	0.19	0.18	0.17	0.16	0.15
METAL FABR.	0.49	0.47	0.45	0.43	0.41
CHEMICAL	0.77	0.81	0.85	0.79	0.72
NON MET MIN.	0.58	0.61	0.65	0.69	0.72
FOOD & BEV.	0.66	0.67	0.67	0.68	0.69
MISC MANUF	0.89	0.87	0.84	0.82	0.79
WHOLSL TRADE	0.56	0.55	0.53	0.52	0.50
C FRASER VAL					
FOREST PROD.	0.01	0.01	0.01	0.01	0.01
METAL FABR.	0.03	0.04	0.05	0.06	0.07
CHEMICAL	0.02	0.03	0.04	0.05	0.06
NON MET MIN.	0.02	0.03	0.04	0.05	0.05
FOOD & BEV.	0.07	0.06	0.09	0.10	0.10
MISC MANUF	0.03	0.03	0.04	0.04	0.05
WHOLSL TRADE	0.03	0.03	0.03	0.04	0.04
DEWDNEY AL.					
FOREST PROD.	0.03	0.03	0.03	0.04	0.04
METAL FABR.	0.00	0.01	0.01	0.01	0.01
CHEMICAL	0.00	0.00	0.00	0.00	0.00
NON MET MIN.	0.01	0.01	0.01	0.01	0.01
FOOD & BEV.	0.01	0.01	0.02	0.02	0.02
MISC MANUF	0.02	0.02	0.03	0.04	0.04
WHOLSL TRADE	0.02	0.02	0.02	0.02	0.02
FRASER CHEAM					
FOREST PROD.	0.01	0.01	0.01	0.02	0.02
METAL FABR.	0.01	0.01	0.01	0.01	0.01
CHEMICAL	0.00	0.00	0.00	0.00	0.00
NON MET MIN.	0.02	0.02	0.02	0.02	0.02
FOOD & BEV.	0.05	0.05	0.05	0.05	0.06
MISC MANUF	0.01	0.01	0.01	0.01	0.01
WHOLSL TRADE	0.02	0.02	0.02	0.02	0.02
OTHER B.C.					
FOREST PROD.	0.76	0.77	0.77	0.78	0.78
METAL FABR.	0.47	0.48	0.48	0.49	0.49
CHEMICAL	0.20	0.15	0.11	0.16	0.21
NON MET MIN.	0.38	0.34	0.28	0.24	0.20
FOOD & BEV.	0.22	0.19	0.17	0.15	0.13
MISC MANUF	0.05	0.06	0.08	0.09	0.11
WHOLSL TRADE	0.38	0.39	0.48	0.41	0.42

DENSITY RATIOS

	1981	1986	1991	1996	2001
G V R D					
FOREST PROD.	0.68	0.68	0.68	0.70	0.71
METAL FABR.	0.90	0.94	0.99	1.07	1.14
CHEMICAL	0.95	0.98	1.03	1.08	1.14
NON MET MIN.	0.48	0.54	0.62	0.71	0.83
FOOD & BEV.	2.62	2.79	2.99	3.26	3.47
MISC MANUF	1.64	1.65	1.68	1.73	1.81
WHOLSL TRADE	4.13	4.29	4.50	4.85	5.23
C FRASER VAL					
FOREST PROD.	0.29	0.29	0.30	0.31	0.33
METAL FABR.	0.95	0.99	1.07	1.18	1.29
CHEMICAL	1.00	1.04	1.10	1.18	1.27
NON MET MIN.	0.10	0.11	0.13	0.16	0.19
FOOD & BEV.	1.30	1.38	1.51	1.68	1.84
MISC MANUF	0.81	0.82	0.85	0.89	0.95
WHOLSL TRADE	2.02	2.10	2.25	2.49	2.72
DEWDNEY AL.					
FOREST PROD.	0.78	0.78	0.72	0.76	0.79
METAL FABR.	1.00	1.05	1.13	1.24	1.36
CHEMICAL	1.00	1.04	1.10	1.18	1.27
NON MET MIN.	0.12	0.14	0.16	0.19	0.22
FOOD & BEV.	2.21	2.35	2.57	2.86	3.13
MISC MANUF	1.36	1.37	1.42	1.49	1.59
WHOLSL TRADE	20.36	21.14	22.72	24.97	27.45
FRASER CHEAM					
FOREST PROD.	0.60	0.60	0.62	0.65	0.68
METAL FABR.	1.00	1.05	1.13	1.24	1.36
CHEMICAL	0.03	0.03	0.03	0.03	0.03
NON MET MIN.	0.10	0.11	0.13	0.16	0.19
FOOD & BEV.	2.26	2.48	2.63	2.93	3.20
MISC MANUF	1.19	1.20	1.24	1.31	1.39
WHOLSL TRADE	7.92	8.22	8.84	9.71	10.68

OUTPUT - ASSUMPTIONS
ANNUAL GROWTH RATES IN %

INDUSTRY	'81 BASE	'81-'86	'86-'91	'91-'96	'96-'01
FOREST PROD.	6963	1.01	2.18	3.77	1.29
METAL FABR.	2239	0.93	2.66	7.18	3.80
CHEMICAL	2356	0.85	1.96	4.37	2.63
NON MET MIN.	438	1.31	2.41	4.91	3.02
FOOD & BEV.	2602	0.63	2.19	4.40	2.60
MISC MANUF	1790	2.10	2.79	6.80	4.80
WHOLSL TRADE	18400	1.98	3.52	5.18	3.03
TOTAL	34788				

OUTPUT--INDUSTRY TOTALS
MILLIONS OF $81

INDUSTRY	1981	1986	1991	1996	2001
FOREST PROD.	6963	7322	8155	9813	10463
METAL FABR.	2239	2345	2674	3782	4557
CHEMICAL	2356	2458	2708	3354	3819
NON MET MIN.	438	467	527	649	776
FOOD & BEV.	2602	2685	2992	3711	4219
MISC MANUF	1790	1986	2279	3058	3855
WHOLSL TRADE	18400	20295	24128	31058	39696
TOTAL	34788	37558	43463	55438	67386

OUTPUT BY REGION
MILLIONS OF $81

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	1322	1313	1378	1535	1521
METAL FABR.	1888	1893	1193	1612	1851
CHEMICAL	1814	1991	2295	2638	2744
NON MET MIN.	252	283	343	464	562
FOOD & BEV.	1783	1786	2018	2534	2989
MISC MANUF	1594	1723	1921	2495	3054
WHOLSL TRADE	10327	11892	12837	16841	19919
TOTAL	18188	19281	21978	27339	32581
C FRASER VAL					
FOREST PROD.	96	66	98	126	151
METAL FABR.	69	99	141	239	332
CHEMICAL	94	81	115	170	221
NON MET MIN.	9	14	21	32	42
FOOD & BEV.	188	212	265	359	435
MISC MANUF	47	63	88	136	194
WHOLSL TRADE	513	649	848	1165	1708
TOTAL	918	1185	1568	2227	2963
DEWDNEY AL.					
FOREST PROD.	186	219	278	357	413
METAL FABR.	9	14	21	38	57
CHEMICAL	4	5	5	7	8
NON MET MIN.	3	3	4	5	5
FOOD & BEV.	31	38	48	66	82
MISC MANUF	34	58	78	113	167
WHOLSL TRADE	285	325	410	561	762
TOTAL	552	654	829	1146	1494
FRASER CHEAM					
FOREST PROD.	82	95	115	148	169
METAL FABR.	14	19	27	44	66
CHEMICAL	4	2	3	3	4
NON MET MIN.	7	7	8	11	12
FOOD & BEV.	128	132	154	203	242
MISC MANUF	25	24	23	24	28
WHOLSL TRADE	285	325	410	561	763
TOTAL	537	684	742	1008	1284
REST OF B.C.					
FOREST PROD.	5327	5628	6311	7447	8209
METAL FABR.	1039	1128	1291	1846	2251
CHEMICAL	468	378	298	537	821
NON MET MIN.	167	159	158	158	154
FOOD & BEV.	560	818	886	549	551
MISC MANUF	98	126	174	288	413
WHOLSL TRADE	6998	7985	9638	12718	16663
TOTAL	14661	15835	18355	23726	29862
REGION TOTAL					
G V R D	18188	19281	21978	27339	32581
C FRASER VAL	918	1185	1568	2227	2963
DEWDNEY AL.	552	654	829	1146	1494
FRASER CHEAM	537	684	742	1008	1284
TOTAL L.M.	20187	21723	25188	31712	38324
REST OF B.C.	14661	15835	18355	23726	29862
TOTAL B.C.	34748	37558	43463	55438	67386

LAND REQUIREMENTS BY REGION
IN ACRES

S V R D	1981	1986	1991	1996	2001
FOREST PROD.	1943	1938	2007	2195	2139
METAL FABR.	1210	1161	1292	1312	1420
CHEMICAL	1912	2022	2225	2436	2420
NON MET MIN.	822	822	884	648	674
FOOD & BEV.	649	641	676	777	838
MISC MANUF	972	1042	1143	1428	1487
WHOLSL TRADE	2382	2584	2852	3089	3086
TOTAL	9710	9912	10478	12316	13175
C FRASER VAL					
FOREST PROD.	161	220	201	402	429
METAL FABR.	73	99	122	203	257
CHEMICAL	84	78	104	144	174
NON MET MIN.	84	120	141	207	229
FOOD & BEV.	120	153	178	213	237
MISC MANUF	61	78	104	153	205
WHOLSL TRADE	254	309	373	470	363
TOTAL	827	1074	1351	1794	2144
DEWDNEY AL.					
FOREST PROD.	244	315	374	472	522
METAL FABR.	9	13	19	31	42
CHEMICAL	4	5	5	6	6
NON MET MIN.	24	24	23	23	24
FOOD & BEV.	14	16	19	23	24
MISC MANUF	23	36	50	74	105
WHOLSL TRADE	14	15	18	22	28
TOTAL	358	424	509	655	753
FRASER CHEAM					
FOREST PROD.	137	139	184	229	259
METAL FABR.	14	18	24	37	49
CHEMICAL	132	132	132	132	132
NON MET MIN.	67	66	64	68	67
FOOD & BEV.	53	55	59	69	74
MISC MANUF	21	28	39	28	28
WHOLSL TRADE	36	39	46	58	71
TOTAL	468	489	538	614	665
REGION TOTALS					
S V R D	9710	9912	10478	12316	13175
C FRASER VAL	827	1074	1351	1794	2144
DEWDNEY AL.	358	424	509	655	753
FRASER CHEAM	468	489	538	614	665
TOTAL L.R.	11355	11901	12861	15378	16736

RATE OF GROWTH
ACRES PER YEAR

REGION TOTAL					
S V R D	N/A	40	152	329	172
C FRASER VAL	N/A	49	55	89	70
DEWDNEY AL.	N/A	13	17	29	20
FRASER CHEAM	N/A	4	8	17	10
TOTAL L.R.	N/A	109	232	464	272

RESIDUAL INDUSTRIES LAND PROJECTIONS
5 YEAR GROWTH RATES

MAJOR TRANS.	'81 BASE	'81-'86	'86-'91	'91-'96	'96-'01
GVRD	9214	0.01	0.01	0.01	0.01
C FRASER VAL	1541	0.01	0.01	0.01	0.01
DENDNEY AL.	0	0.01	0.01	0.01	0.01
FRASER CHEAM	484	0.01	0.01	0.01	0.01
OTHER TRANS					
GVRD	1876	0.05	0.05	0.05	0.05
C FRASER VAL	314	0.05	0.05	0.05	0.05
DENDNEY AL.	23	0.05	0.05	0.05	0.05
FRASER CHEAM	381	0.05	0.05	0.05	0.05
UTILITIES					
GVRD	3184	0.01	0.01	0.01	0.01
C FRASER VAL	28	0.20	0.20	0.20	0.20
DENDNEY AL.	2	0.20	0.20	0.20	0.20
FRASER CHEAM	35	0.20	0.20	0.20	0.20

RESIDUAL INDUSTRIES LAND PROJECTIONS
IN ACRES

MAJOR TRANS.	1981	1986	1991	1996	2001
GVRD	9214	9306	9399	9493	9588
C FRASER VAL	1541	1556	1572	1588	1604
DEWDNEY AL.	0	0	0	0	0
FRASER CHEAM	484	489	494	499	504
TOTAL	11239	11351	11465	11580	11695
OTHER TRANS					
GVRD	1876	1970	2068	2172	2280
C FRASER VAL	314	330	346	363	382
DEWDNEY AL.	23	24	25	27	28
FRASER CHEAM	381	400	420	441	463
TOTAL	2594	2724	2860	3003	3153
UTILITIES					
GVRD	3184	3135	3166	3198	3230
C FRASER VAL	28	34	48	48	58
DEWDNEY AL.	2	2	3	3	4
FRASER CHEAM	35	42	58	69	73
TOTAL	3169	3213	3268	3318	3365

CORNER PARAMETERS

REPORT MODULE
(REPMOD)

A110
Land Requirements
By Region
F192

H110
% Share
Land Requirements
By Region
M192

O110
Average
Annual Increase
Land Requirements
By Region
T192

V110
Cumulative Increase
Land Requirements
By Region
AA192

TOTAL LAND REQUIREMENTS
IN ACRES

S V R D	1981	1986	1991	1996	2001
FOREST PROD.	1943	1938	2007	2195	2138
METAL FABR.	1210	1161	1202	1512	1428
CHEMICAL	1912	2022	2235	2436	2428
NON MET MIN.	522	522	554	648	674
FOOD & BEV.	649	641	676	777	838
MISC MANUF	972	1042	1143	1438	1487
TOT MANUF	7208	7326	7818	9006	9369
WHOLSL TRADE	2582	2586	2852	3389	3086
MAJOR TRANS	9214	9386	9399	9493	9388
OTHER TRANS	1876	1978	2068	2172	2288
UTILITIES	3184	3135	3166	3198	3238
TOTAL	23984	24323	25384	27178	28273

C FRASER VAL					
FOREST PROD.	161	228	381	482	459
METAL FABR.	73	99	132	203	257
CHEMICAL	84	78	104	144	174
NON MET MIN.	86	128	161	207	229
FOOD & BEV.	138	153	175	213	237
MISC MANUF	61	78	104	153	205
TOT MANUF	573	765	978	1323	1560
WHOLSL TRADE	234	289	373	478	583
MAJOR TRANS	1541	1556	1572	1588	1604
OTHER TRANS	314	338	346	343	362
UTILITIES	28	34	48	46	58
TOTAL	2710	2994	3389	3793	4187

DEWDNEY AL.					
FOREST PROD.	266	315	376	472	522
METAL FABR.	9	13	19	31	42
CHEMICAL	4	5	5	6	6
NON MET MIN.	26	24	23	25	24
FOOD & BEV.	14	16	19	23	26
MISC MANUF	25	36	50	76	105
TOT MANUF	344	409	491	632	725
WHOLSL TRADE	14	15	18	22	28
MAJOR TRANS	0	0	0	0	0
OTHER TRANS	23	24	25	27	28
UTILITIES	2	2	3	3	4
TOTAL	383	451	538	685	785

FRASER CHEAM					
FOREST PROD.	137	159	186	229	258
METAL FABR.	14	18	24	37	49
CHEMICAL	132	132	132	132	132
NON MET MIN.	67	64	64	68	67
FOOD & BEV.	53	55	59	69	76
MISC MANUF	21	28	19	28	28
TOT MANUF	424	458	484	554	593
WHOLSL TRADE	36	39	46	58	71
MAJOR TRANS	484	489	494	499	504
OTHER TRANS	381	488	428	441	463
UTILITIES	35	42	58	68	73
TOTAL	1360	1428	1494	1614	1704

S V R D	23984	24323	25384	27178	28273
C FRASER VAL	2710	2994	3389	3793	4187
DEWDNEY AL.	383	451	538	685	785
FRASER CHEAM	1360	1428	1494	1614	1704
TOTAL L.R.	28357	29189	30645	33271	34950

TOTAL LAND REQUIREMENTS
SHARE OF TOTALS

G V R D	1981	1986	1991	1996	2001
FOREST PROD.	0.08	0.08	0.08	0.08	0.08
METAL FABR.	0.05	0.05	0.05	0.06	0.06
CHEMICAL	0.08	0.08	0.09	0.09	0.09
NON MET MIN.	0.02	0.02	0.02	0.02	0.02
FOOD & BEV.	0.03	0.03	0.03	0.03	0.03
MISC MANUF	0.04	0.04	0.05	0.05	0.06
TOT MANUF	0.30	0.30	0.31	0.33	0.33
WHOLSL TRADE	0.10	0.11	0.11	0.12	0.13
MAJOR TRANS	0.39	0.38	0.37	0.35	0.34
OTHER TRANS	0.08	0.08	0.08	0.08	0.08
UTILITIES	0.13	0.13	0.13	0.12	0.11
TOTAL	1.00	1.00	1.00	1.00	1.00
C FRASER VAL					
FOREST PROD.	0.06	0.08	0.09	0.11	0.11
METAL FABR.	0.03	0.03	0.04	0.05	0.06
CHEMICAL	0.02	0.03	0.03	0.04	0.04
NON MET MIN.	0.03	0.04	0.05	0.05	0.05
FOOD & BEV.	0.05	0.05	0.05	0.06	0.06
MISC MANUF	0.02	0.03	0.03	0.04	0.05
TOT MANUF	0.21	0.26	0.30	0.35	0.37
WHOLSL TRADE	0.09	0.10	0.11	0.12	0.14
MAJOR TRANS	0.57	0.52	0.48	0.42	0.38
OTHER TRANS	0.12	0.11	0.10	0.10	0.09
UTILITIES	0.01	0.01	0.01	0.01	0.01
TOTAL	1.00	1.00	1.00	1.00	1.00
DEWDNEY AL.					
FOREST PROD.	0.69	0.70	0.70	0.69	0.66
METAL FABR.	0.02	0.03	0.04	0.05	0.05
CHEMICAL	0.01	0.01	0.01	0.01	0.01
NON MET MIN.	0.07	0.05	0.04	0.04	0.03
FOOD & BEV.	0.04	0.04	0.03	0.03	0.03
MISC MANUF	0.07	0.08	0.09	0.11	0.13
TOT MANUF	0.90	0.91	0.91	0.92	0.92
WHOLSL TRADE	0.04	0.03	0.03	0.03	0.04
MAJOR TRANS	0.00	0.00	0.00	0.00	0.00
OTHER TRANS	0.04	0.05	0.05	0.04	0.04
UTILITIES	0.01	0.01	0.01	0.01	0.01
TOTAL	1.00	1.00	1.00	1.00	1.00
FRASER CHEAM					
FOREST PROD.	0.10	0.11	0.12	0.14	0.15
METAL FABR.	0.01	0.01	0.02	0.02	0.03
CHEMICAL	0.10	0.09	0.09	0.08	0.08
NON MET MIN.	0.05	0.05	0.04	0.04	0.04
FOOD & BEV.	0.04	0.04	0.04	0.04	0.04
MISC MANUF	0.02	0.01	0.01	0.01	0.01
TOT MANUF	0.31	0.32	0.32	0.34	0.35
WHOLSL TRADE	0.03	0.03	0.03	0.04	0.04
MAJOR TRANS	0.34	0.34	0.33	0.31	0.30
OTHER TRANS	0.28	0.28	0.28	0.27	0.27
UTILITIES	0.03	0.03	0.03	0.04	0.04
TOTAL	1.00	1.00	1.00	1.00	1.00
G V R D	0.04	0.03	0.03	0.02	0.01
C FRASER VAL	0.10	0.10	0.11	0.11	0.12
DEWDNEY AL.	0.01	0.02	0.02	0.02	0.02
FRASER CHEAM	0.05	0.05	0.05	0.05	0.05
TOTAL L.R.	1.00	1.00	1.00	1.00	1.00

TOTAL LAND REQUIREMENTS
AVERAGE ANNUAL CHANGE IN ACRES

S V R D	'81 BASE	'81-'86	'86-'91	'91-96	'96-'01
FOREST PROD.	1943	-1	14	30	-13
METAL FABR.	1210	-10	8	42	22
CHEMICAL	1912	22	43	40	-3
NON MET MIN.	522	8	7	19	8
FOOD & BEV.	649	-2	7	28	12
MISC MANUF	972	14	28	89	58
TOT MANUF	7208	24	98	238	73
WHOLSL TRADE	2382	17	33	91	99
MAJOR TRANS	9214	18	19	19	19
OTHER TRANS	1876	19	28	21	22
UTILITIES	3184	6	6	6	6
TOTAL	23984	84	196	375	219
C FRASER VAL					
FOREST PROD.	161	13	15	20	11
METAL FABR.	73	5	7	14	11
CHEMICAL	54	5	5	8	6
NON MET MIN.	86	8	7	9	4
FOOD & BEV.	138	3	4	8	5
MISC MANUF	61	3	5	10	10
TOT MANUF	573	38	43	69	47
WHOLSL TRADE	254	11	13	19	23
MAJOR TRANS	1541	3	3	3	3
OTHER TRANS	314	3	3	3	4
UTILITIES	28	1	1	2	2
TOTAL	2710	57	63	97	79
DEWDNEY AL.					
FOREST PROD.	266	18	12	19	18
METAL FABR.	9	1	1	2	2
CHEMICAL	4	0	0	0	0
NON MET MIN.	26	0	0	0	0
FOOD & BEV.	14	0	1	1	1
MISC MANUF	25	2	3	5	4
TOT MANUF	344	13	16	28	19
WHOLSL TRADE	14	0	1	1	1
MAJOR TRANS	0	0	0	0	0
OTHER TRANS	23	0	0	0	0
UTILITIES	2	0	0	0	0
TOTAL	383	14	17	29	20
FRASER CHEAM					
FOREST PROD.	137	4	5	9	4
METAL FABR.	14	1	1	3	2
CHEMICAL	132	0	0	0	0
NON MET MIN.	67	0	0	1	0
FOOD & BEV.	53	0	1	2	1
MISC MANUF	21	0	0	0	0
TOT MANUF	424	5	7	15	7
WHOLSL TRADE	36	1	1	2	3
MAJOR TRANS	484	1	1	1	1
OTHER TRANS	381	4	4	4	4
UTILITIES	35	1	2	2	2
TOTAL	1360	12	15	24	18
S V R D	23984	84	196	375	219
C FRASER VAL	2710	57	63	97	79
DEWDNEY AL.	383	14	17	29	20
FRASER CHEAM	1360	12	15	24	18
TOTAL L.R.	28357	166	291	525	336

TOTAL LAND REQUIREMENTS
CUMULATIVE CHANGE IN ACRES

G V R D	'81 BASE	'81-'86	'86-'91	'91-96	'96-'01
FOREST PROD.	1943	-5	64	252	187
METAL FABR.	1218	-49	-8	382	418
CHEMICAL	1912	110	323	524	588
NON MET MIN.	822	0	54	126	152
FOOD & BEV.	649	-8	27	128	189
MISC MANUF	972	70	171	466	715
TOT MANUF	7288	118	618	1798	2161
WHOLSL TRADE	2382	84	358	887	1384
MAJOR TRANS	9214	92	185	279	374
OTHER TRANS	1876	94	192	296	484
UTILITIES	3184	31	62	94	126
TOTAL	23984	419	1488	3275	4369
C FRASER VAL					
FOREST PROD.	161	67	148	241	298
METAL FABR.	73	26	59	130	184
CHEMICAL	54	24	58	98	120
NON MET MIN.	86	42	75	121	143
FOOD & BEV.	138	15	37	75	99
MISC MANUF	61	17	43	92	144
TOT MANUF	573	192	485	758	987
WHOLSL TRADE	254	55	119	216	329
MAJOR TRANS	1541	15	31	47	63
OTHER TRANS	314	16	32	49	68
UTILITIES	28	6	12	20	30
TOTAL	2718	284	599	1083	1477
DEWDNEY AL.					
FOREST PROD.	266	49	118	206	256
METAL FABR.	9	4	10	22	33
CHEMICAL	4	1	1	2	2
NON MET MIN.	26	-2	-3	-1	-2
FOOD & BEV.	14	2	5	9	12
MISC MANUF	25	11	25	51	88
TOT MANUF	344	65	147	288	381
WHOLSL TRADE	14	1	4	8	14
MAJOR TRANS	0	0	0	0	0
OTHER TRANS	23	1	2	4	5
UTILITIES	2	0	1	1	2
TOTAL	383	68	155	302	402
FRASER CHEAM					
FOREST PROD.	137	22	49	92	113
METAL FABR.	14	4	10	23	35
CHEMICAL	132	0	0	0	0
NON MET MIN.	67	-1	-3	1	0
FOOD & BEV.	53	2	6	16	23
MISC MANUF	21	-1	-2	-1	-1
TOT MANUF	424	26	60	132	169
WHOLSL TRADE	36	3	10	22	35
MAJOR TRANS	484	5	10	15	20
OTHER TRANS	381	19	39	60	82
UTILITIES	35		15	25	38
TOTAL	1360	68	134	254	344
G V R D	23984	419	1488	3275	4369
C FRASER VAL	2718	284	599	1083	1477
DEWDNEY AL.	383	68	155	302	402
FRASER CHEAM	1360	68	134	254	344
TOTAL L.R.	28357	832	2288	4914	6592

POOR

QUALITY

ORIGINAL